MACHINE DESIGN

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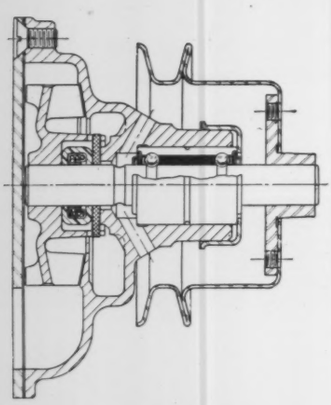

Information about this bearing and its application will be gladly furnished upon request.

● This bearing actually gave this mileage in truck service . . . *and is still good for many more.* It had no attention. It needed no attention. It was *built to be forgotten.*

Self-sealed, lubricated-for-life, the New Departure Fan and Pump Shaft ball bearing gives highly accurate support for both fan and pump—assures maximum life for the water seal and eliminates all need for periodic lubrication or adjustment. It is service-proved.

2739

NEW DEPARTURE Ball Bearings

New Departure • Division General Motors Corporation • Bristol, Connecticut

NOTHING ROLLS LIKE A BALL

Itemized Index

CLASSIFIED FOR CONVENIENCE WHEN STUDYING SPECIFIC DESIGN PROBLEMS

KEY: EDIT., EDITORIAL PAGES; ADV., ADVERTISING PAGES; R, RIGHT-HAND COLUMN; L, LEFT-HAND COLUMN

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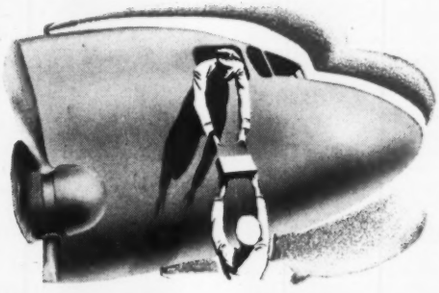
An Overworked Word

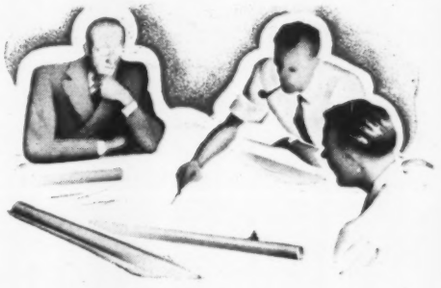
Gets a Shot in the Arm

Just what is this word "service"? . . . A salesman's promise? . . . An embroidered motto gathering dust on the shipping room wall? Do the thousands who use it every day really stop to think what it means?

Most manufacturers don't misuse the word "service". They live up to it, in terms of promptness. Fafnir customers like promptness, too . . . and *get* it . . . Witness the Detroit customer who rang us up at 12:15 the other noon-day for a WIR 320 (weight about 20 pounds) . . . It arrived in Detroit that evening at 6:30 and was carrying its half-ton load frictionlessly an hour and a half later.

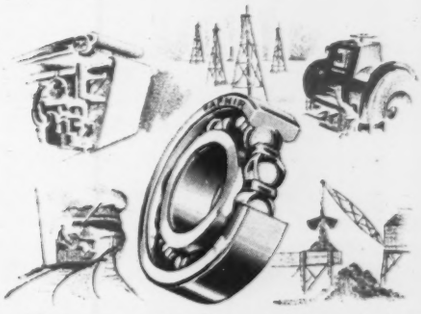


It's dramatic to rush a big ball bearing halfway across the continent between noon and nightfall . . . but to Fafnir, Service goes much deeper into customer-relations than mere promptness in putting an idle shaft back to work. For Fafnir knows that the careful, painstaking, undramatic service rendered to *prevent* emergencies means far more to bearing users than hustle and bustle when a breakdown comes.



Take a typical case . . . a plant where keen-eyed engineers are ruling lines on paper . . . lines which will some day take shape as a new, more efficient machine. You say they don't need Fafnir Service yet? *Their Fafnir Service started long ago,* with the development of the most complete line of ball bearings in America . . . started with the training of Fafnir engineers now familiar with the field into which the new machine will go . . . conversant with the problems involved in adapting ball bearings to its shafts. Or perhaps their Fafnir Service started when some special bearing type was extended, as is Fafnir's policy, into a full range of sizes within which their exact needs will be met.

As the months go by, and their machine swings into production, they will thank Fafnir for another phase of Service . . . the balance in industries served . . . which dictates that Fafnir's customer-list shall maintain its breadth . . . so that either a recession or a sudden boom in any industry shall in no way affect Fafnir's ability to serve the remainder.



Then, some day years hence, when a long-used Fafnir in one of their machines requires replacement . . . a Fafnir representative may drive all night . . . or an airliner may carry a package. Someone will remark, "Quick service!" . . . And the Fafnir customer will smile to himself, thinking how small a part of Fafnir Service the rush delivery truly represents. The Fafnir Bearing Company, New Britain, Connecticut.

BALANCE IN ORGANIZATION

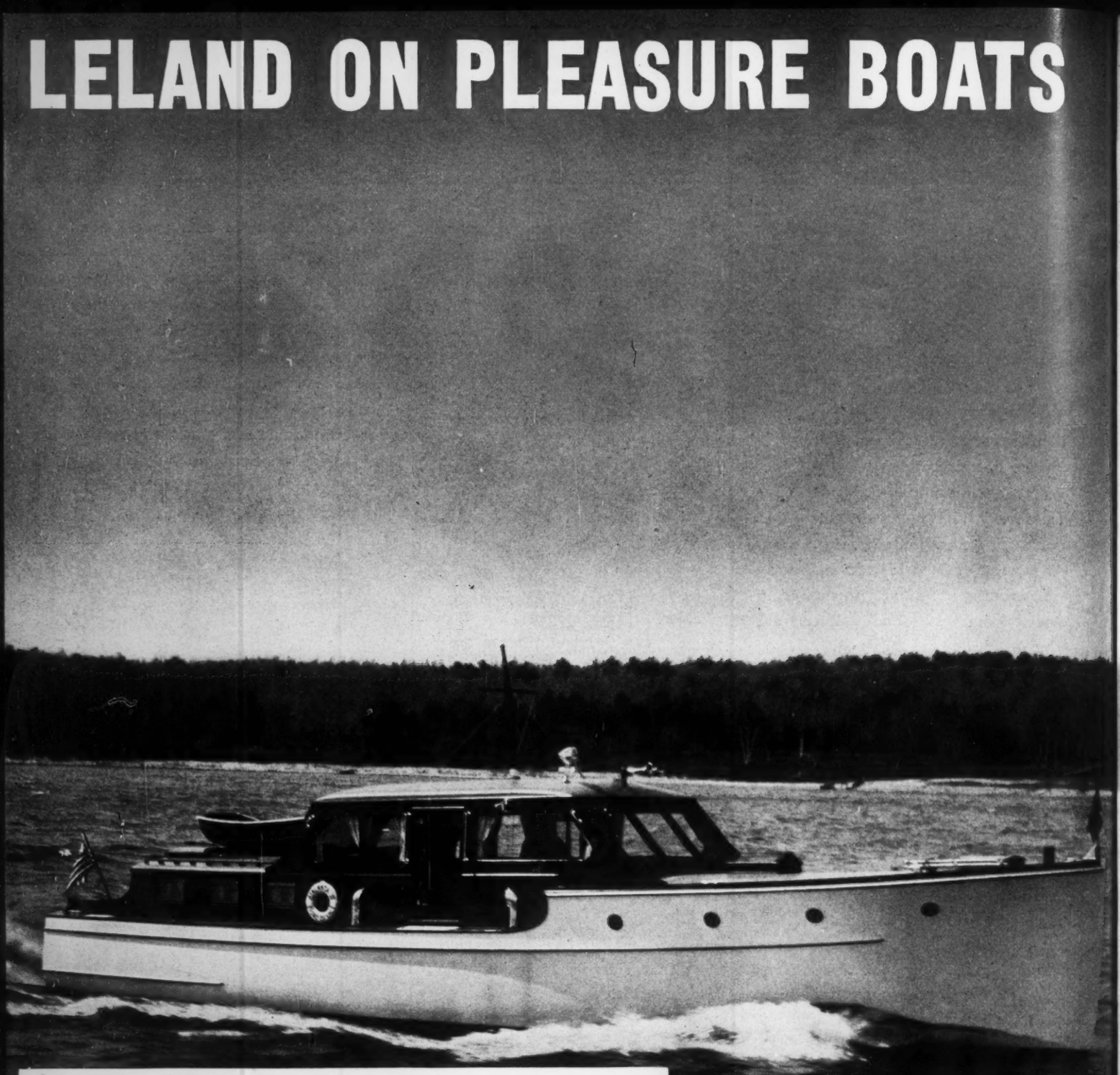
In the Fafnir organization, customer-minded production men are balanced with production-minded sales engineers. The resulting teamwork provides customer service and cooperation of an unusual sort. . . . And Fafnir executives spend much of their time in the field. Results: Fafnir production schedules are geared to customers' needs. The minds of those who guide this Company harbor none of the intolerance that grows in men who see no farther than their shipping rooms.

Ball Bearings

THE BALANCED LINE . . .

MOST COMPLETE IN AMERICA

LELAND ON PLEASURE BOATS

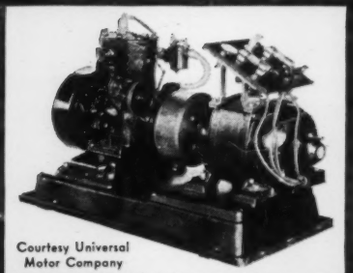


Through the magic of a Leland electric generator, life aboard this modern pleasure cruiser is pretty much like living at home. Electric lights, radio, hot-plate, and water heater . . . a Leland generator helps supply power for them all.

Builders of marine light plants like the way Leland generators perform. They know . . . as do manufacturers of oil burners, gasoline pumps, machine tools, and scores of other appliances . . . that Leland motors and generators operate efficiently and with unfailing dependability. . . . . .

In fact, it is a rare appliance that cannot be profitably driven by a Leland motor. That is why we suggest that you obtain one for comparison and test. Note how it gives new performance appeal and eye appeal to your product. The Leland Electric Company, Dayton, Ohio.

More Than 200 Fully Equipped Service Stations



Courtesy Universal Motor Company

LELAND MOTORS

The Story *of the* Distraught Designer

AND HOW DU PONT NEOPRENE SOLVED HIS PROBLEM

THAT NIGHT four years ago, lights burned late in the mechanical sander company's drafting room.

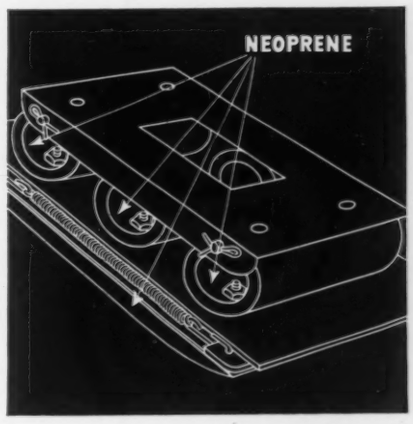
An automobile body manufacturer had ordered a number of high-speed sanders to be used with gasoline in a new sanding process, and the designing of these presented a serious problem.

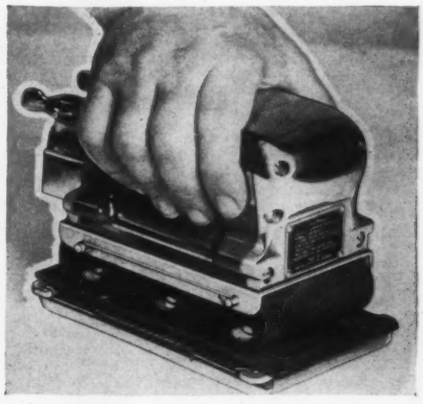
Obviously the company's standard dry and water sander wouldn't do. For although its "floating" pads had all the flexibility needed for sharply curved surfaces, its tubular rollers and sanding block were made of rubber. And rubber wouldn't last long with gasoline.

The designer had already tried a wide variety of other materials, all without success. Some were resilient enough but wouldn't stand gasoline. Others stood gasoline but weren't resilient enough.

It was only when this designer turned to his file on neoprene, Du Pont's chloroprene rubber, that he found the answer to his problem. For here his data showed him that although neoprene has the resiliency, strength and toughness of natural rubber, it is far superior in resistance to gasoline, not to mention oils, ozone and aging.

This is only one of the thousands of cases where neoprene has solved a knotty problem of design. We hope that it will suggest ways in which neoprene can be useful to you, too. For further information about this remarkable material, write for your free copy of the interesting, illustrated Neoprene Handbook.





Speed-Bloc Sander manufactured by Sterling Products Company, Detroit, Michigan.

DU PONT
REG. U.S. PAT. OFF.

NEOPRENE

E. I. du Pont de Nemours & Co., Inc.
Rubber Chemicals Division
Wilmington, Delaware

The ALPHA PROCESS BERMAX ALLOY C-S METAL OF BEARINGS FOR MACHINE APPLICATIONS

A PRIMER on your bearing and bushing problems might begin and end with these three logical suggestions: Consult a manufacturer with specialized experience in this field; tell him your problem, and, let him submit his recommendations and reasons therefor.

Federal-Mogul offers just such a service, with forty years' specialized experience in developing designs and alloys, and manufacturing many millions of bearings and bushings for a multitude of uses. This background offers you definite advantages. For example, wide knowledge gained in the development of Federal-Mogul's Precision Insert bearings in the automotive industry has brought remarkable advantages and economies in the machine field.

Federal-Mogul's exclusive Alpha Process, Bermax Alloy and C-S Metal developments also offer you unusual improvements in bearing and bushing performance and cost. Your inquiry incurs no obligation—full details will be sent gladly.

FEDERAL Mogul

ALPHA PROCESS

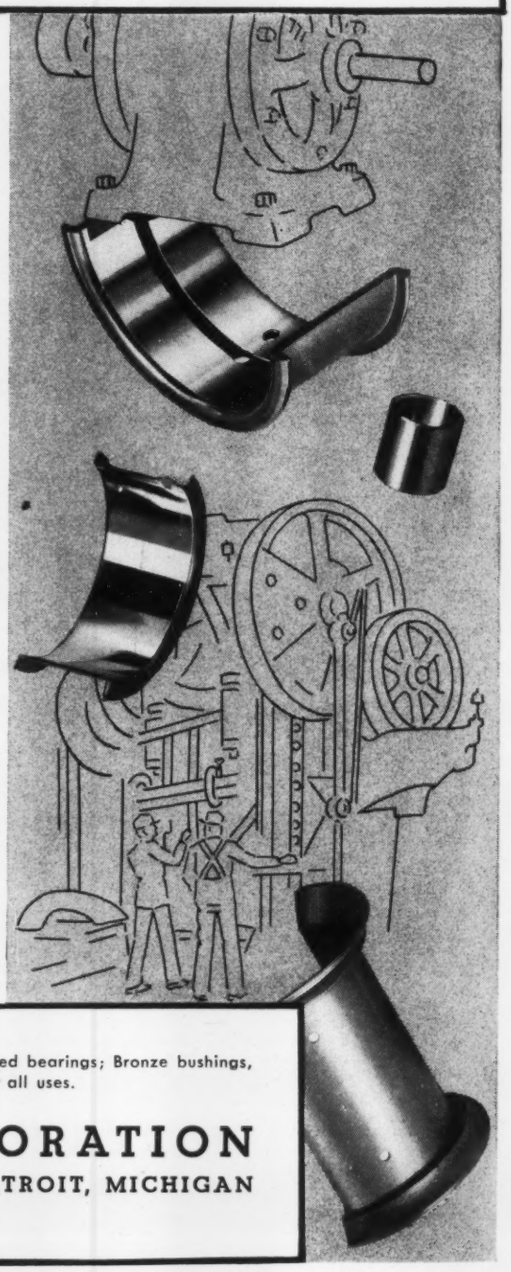
is a method of manufacturing bearings to obtain the highest possible life expectancy. It has proved, by rigid practical test, that bearings or bushings made to the same design, with identical materials, but by different manufacturing methods, vary greatly in serviceable life, and, of course, in ultimate cost. An interesting analysis of these tests, showing what you get for your bearing dollar, sent free. Ask for "Bearing Construction—Its Relation to Performance and Life."

BERMAX ALLOY

developed in Federal-Mogul's extensive chemical, metallurgical and engineering laboratories, has, over a period of years, turned in excellent performance records. It is ideally suited for many machine applications, can be poured, die-cast or spun into bearings with exceptional ease and freedom from usual difficulties. On machine bearings, where cost is a dominating factor yet a high degree of performance is essential, Bermax provides the solution.

C-S METAL

is one of the most important developments in recent years. Precision Insert bearings with this Cadmium-Silver-Copper lining are now generally used by leading manufacturers of automotive and Diesel engines—and this experience has shown that C-S Metal is an answer for those machine uses where high speed and high temperature operation combine to cause early bearing failure. C-S Metal's records under these conditions satisfy the most critical user. An article by A. B. Willi, Chief Engineer, tells more of this interesting discovery. A copy will be sent free.



Steel-back and Bronze-back, Babbitt-lined and Steel-back Cadmium-silver-copper lined bearings; Bronze bushings, washers, castings and bars (cored and solid); Babbitt metals for all uses.

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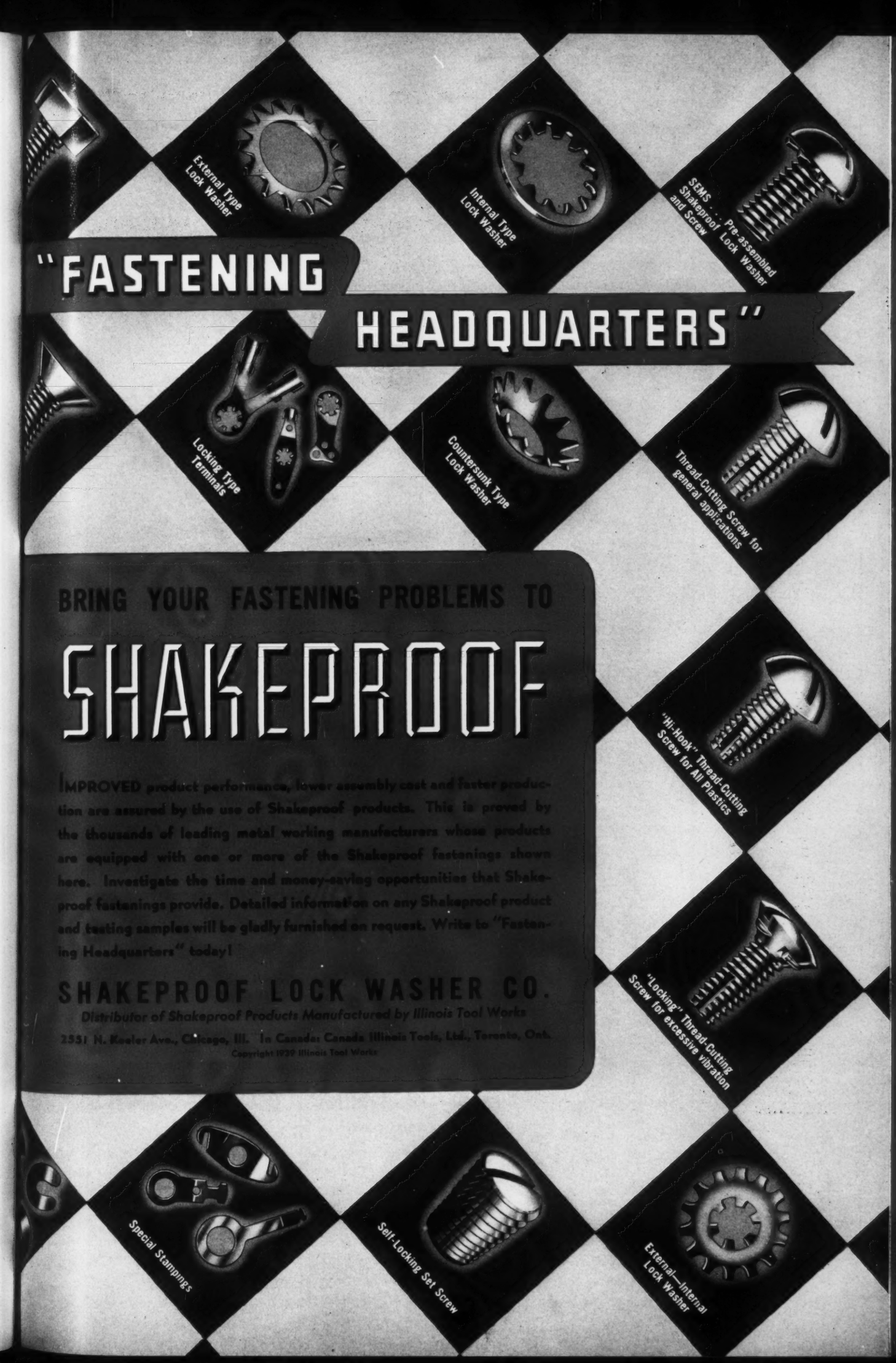
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✓ REDUCED WASTE • • •

We are equipped to furnish Amercut Cold Finished Steel Bars in any size rounds from 1/32" diameter up to and including 6". We also produce a wide range of sizes and shapes of bars to supply every need. We suggest that you consult our Sales Department or Service Engineers for requirements that are other than standard.

You get them all!

WHEN you use Cold Finished Steel Bars in producing machined parts, you get all of these money saving advantages. Parts machined from Cold Finished Steel Bars can be made with great accuracy with a minimum of machining operations, and when completed have that smooth, shining finish which otherwise can be obtained only with additional work.

Amercut Cold Finished Steel Bars will give you the quality and uniformity characteristic of products manufactured by the American Steel & Wire Company. The cold drawing operation employed in making these bars improves the physical properties of the steel and gives it a smooth finish and accurate size. For this reason there is no need for turning down the bar to remove surface imperfections, and considerable savings can be made in scrap and turnings as well as in time. For more than half a century these bars have been producing the finest results wherever they have been used.

Amercut Cold Finished Steel Bars are kind to your tools. Uniformity and freedom from imperfections not only improve their machinability but lengthen tool life.

Amercut Cold Finished Steel Bars are available in any type or grade you need and can be produced in the exact analysis and finish you require. We will be glad to furnish you with technical assistance at any time.

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UNITED STATES STEEL

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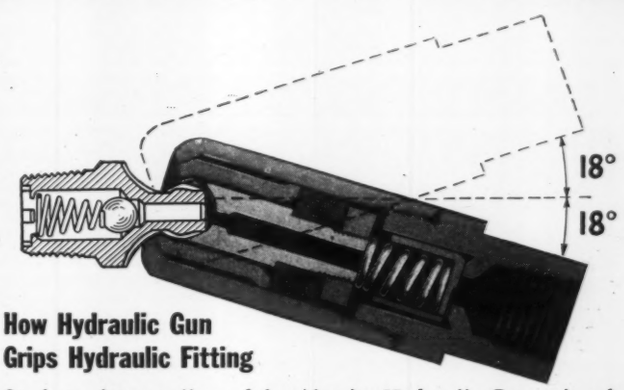
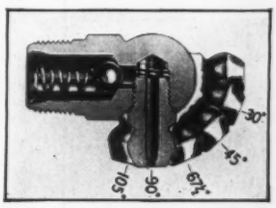


How Hydraulic Gun Grips Hydraulic Fitting

See how the coupling of the Alemite Hydraulic Gun grips the nose of the Alemite Hydraulic Fitting to form a leakproof seal—a seal which grows tighter as pressure is increased! Gun may be arced as much as 18° in any direction without breaking the seal, for greater convenience in reaching remote bearings.

ALEMITE HYDRAULIC GUN MODEL 5586

Holds 9 oz. semi-solid lubricant; quickly filled through filler-type handle with Alemite Filler Tank; easily operated with one hand—can't slip off fitting. Delivers predetermined quantity of lubricant at each shot; up to 10,000 lbs. pressure per sq. in. Gun coupling has three jaws which grasp fitting on contact, forming leakproof seal.



HYDRAULIC FITTINGS AVAILABLE IN ANGLES

Alemite Hydraulic Fittings are made in all desired angles, and are cyanide hardened to stand up under severe use over a long period of time. Every fitting must stand rigid factory inspection before shipment, to safeguard the bearings on your machines.

INSURE LONGER LIFE AND BETTER SATISFACTION FOR YOUR MACHINES —STANDARDIZE ON ALEMITE!

WHETHER you're designing a new type conveyor or some other machine, *CLEAN lubrication is going to be important to your customers.* Keeping lubricant *in* bearings and *off* products, machines, and floors means expensive contamination avoided—means no belt deterioration through oil drippage—means, in many cases, reduced fire hazard.

But most important of all, Alemite Lubrication as standard equipment on your new machine means that lubrication is made easy—and when it's made easy, *it won't be neglected!* Dependable, positive lubrication of every bearing means longer life, better service, greater satisfaction.

Prospective customers are immediately satisfied that you've chosen the best when your specifications say, *"Lubrication: Alemite."* They ask no questions, demand no explanations. Industry knows Alemite to be at the top of the list for steady, year-in-and-year-out dependability!

ALEMITE

REG. U. S. PAT. OFF.

A Subsidiary of Stewart-Warner Corporation

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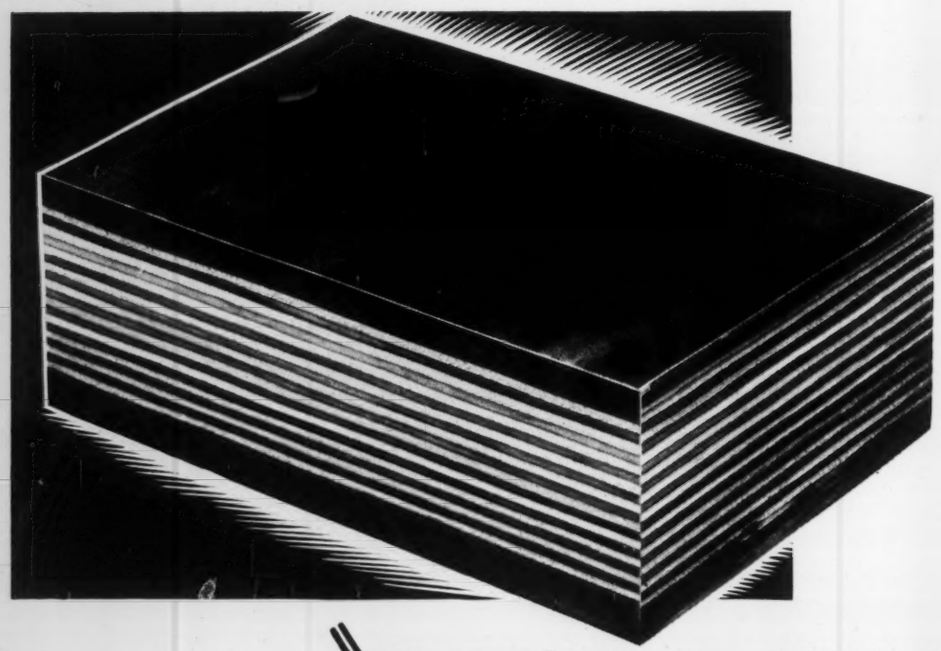
Stewart-Warner-Alemite Corporation of Canada, Ltd., Belleville, Ontario

WORLD'S LARGEST MANUFACTURER OF LUBRICATION PRODUCTS



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Light and Strong for Mechanical Uses

Thin laminations of wood impregnated with phenolic resins and vulcanized into a hard homogeneous sheet are offered by Formica in a new product which is remarkable for its lightness and strength and ability to hold its dimensions under extreme conditions . . . "Pregwood" is lighter than aluminum (specific gravity 1.35) and has a flexural strength of 25,000 to 30,000 lbs. per square inch. It is highly resistant to moisture absorption and has a low co-efficient of thermal expansion . . . This material is offered in sheets of a minimum thickness of ¼ of an inch, and 20 inches wide by 96 inches long. It is a light, strong, stable material that should have many uses. Samples on request.

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FORMICA

BONUS

Shafer self-alignment is an integral feature of the bearing itself—a function of the exclusive CONCAVE roller design. Self-aligning action is always available; this bearing delivers free rolling performance with undiminished load carrying capacity even in the presence of shaft deflection or misaligment.

Only Shafer Bearings combine 1. Integral self-alignment, 2. Capacity for radial, thrust, or combined radial-thrust loads, 3. Simple adjustability.

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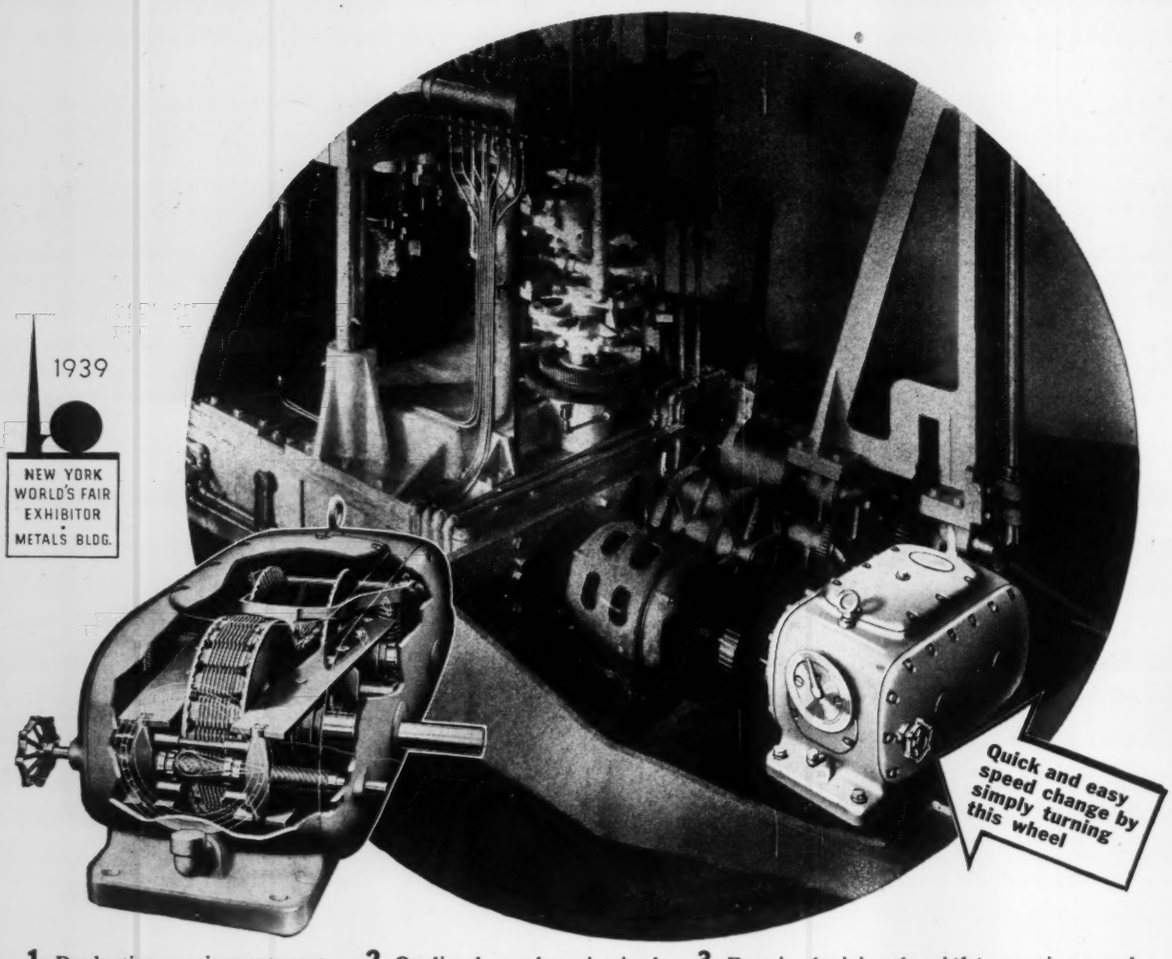
Write for Catalog 14 with complete information.

SHAFER BEARING CORPORATION, 35 EAST WACKER DRIVE, CHICAGO, ILLINOIS

SHAFER SELF-ALIGNING ROLLER BEARINGS

HOW P.I.V. Gear Helped Engineer Attain Three Important Objectives in Machine Design



1. Production requirements met. **2.** Quality demands maintained. **3.** Ease in obtaining the *right* operating speed.

● The engineer who designed this bottle blow-machine, included P. I. V. Gear variable speed control to assure that the painstaking care used in selecting and mixing materials would not be nullified in the actual forming operation.

At the turn of a hand wheel on the P.I.V Gear, while the machine is in operation, its speed can be regulated to produce from 15 to 36 bottles per minute, as may be required. It is unnecessary to stop the machine to change gears, so production is continued and manufacturing routine undisturbed. In the designing engineer's own words, "The P. I. V. Gear enables us to set the machine to operate at the highest speed practicable for production of good ware." It has been proved in hundreds of installations that the capacity of the P.I.V. Gear unit for accurate speed adjustment to meet changing conditions in materials, temperature, mass consistencies, and production requirements, is a powerful factor in eliminating waste, promoting uniformity, and increasing salable output. Toothed contacts of the P. I. V. Gear assure positive transmission, avoiding the fluctuations caused by slippage, inherent in friction drives.

LINK-BELT P.I.V. GEAR SPEED VARIATOR

Every engineer and designer should have a copy of Book 1574, as well as books on the other Link-Belt positive drives illustrated below.

Link-Belt Company, Philadelphia, Indianapolis, Chicago, San Francisco, Atlanta, Toronto. Offices in Principal Cities.

7565

LINK-BELT POSITIVE DRIVES INCLUDE

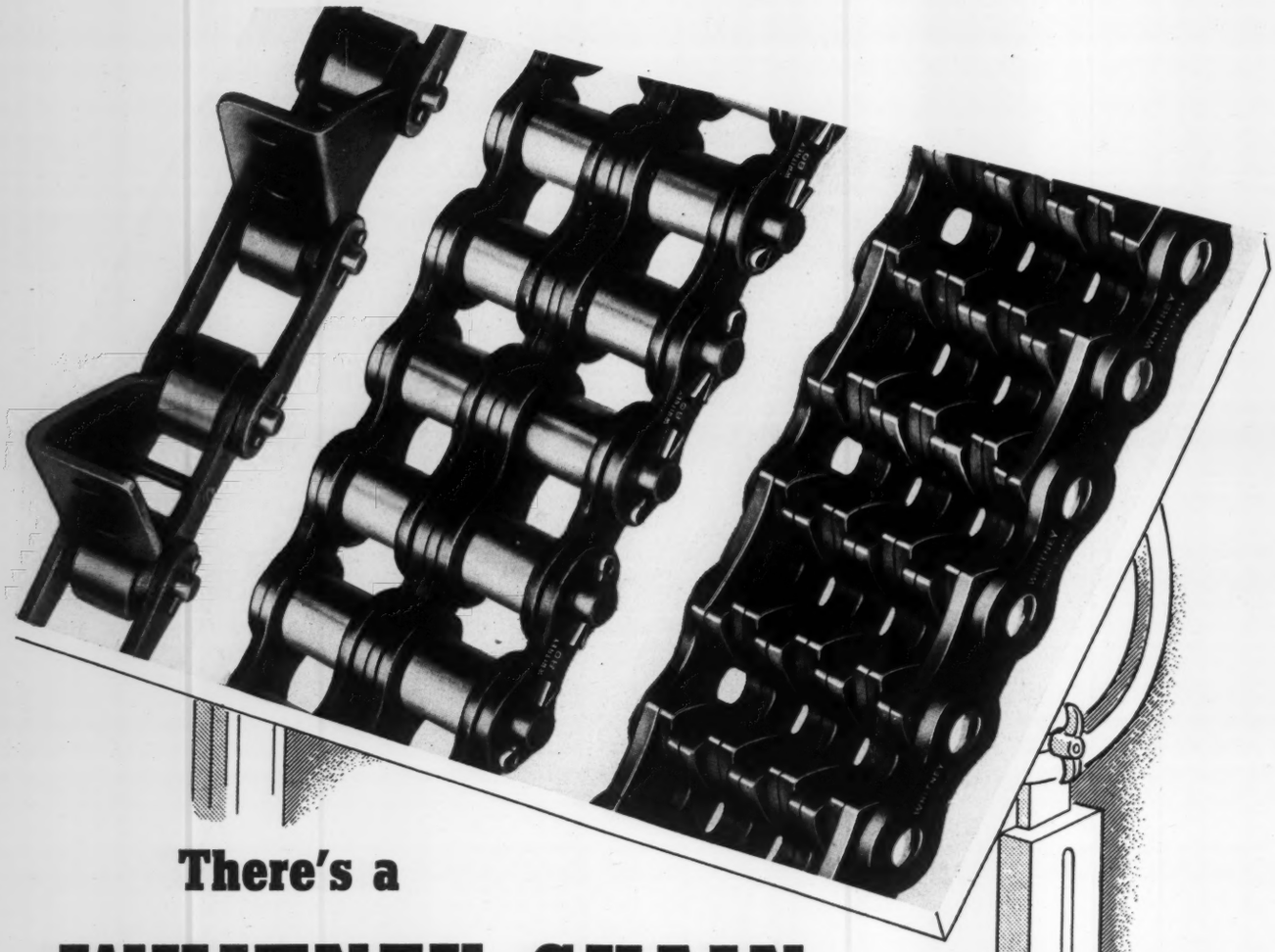
PLASTICS PROBLEM NO. 1

SOLVED THE G-E WAY

PARTS: Textolite molded housing and cover. **USE OF PARTS:** Used as the complete housing for the new Gillette Dry Shaver, manufactured by the Gillette Safety Razor Co., Boston, Mass. **CUSTOMER'S PROBLEM:** The Gillette Dry Shaver provided two molding problems, involving undercuts and metal inserts molded-in at an angle. The off-set head was necessary to secure a natural shaving angle, and streamlining the connector plug so that it would become a part of the razor design required a through slot, open to the sides, in the molded housing. **SOLVED THE G-E WAY:** First, G-E design engineers suggested slight changes in the location of the parting line of the housing and cover to provide a better fit, improve the appearance, and assure greater molding economy. This change in design placed both of the major problems in one part, the housing. Overcoming these problems was a matter of sound engineering in the designing and building of molds, and the use of modern machine tools. G-E mold designers constructed the molds so that the parts could be molded in regular, fast production with maximum ease, quality, and economy. ● Mold design is one of the important phases of superior molding. On it depends the successful molding of difficult jobs, like the Gillette housing. General Electric offers you the same engineering, designing, and manufacturing facilities. There is no better way for simplicity, reliability, and economy than THE G-E WAY. For information, write Section M-29, Plastics Dept., General Electric Co., One Plastics Ave., Pittsfield, Mass.

PD-191A

GENERAL ELECTRIC



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that will work into Your design... and work out smoothly in Service

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The WHITNEY CHAIN & MANUFACTURING COMPANY, *Hartford, Connecticut*

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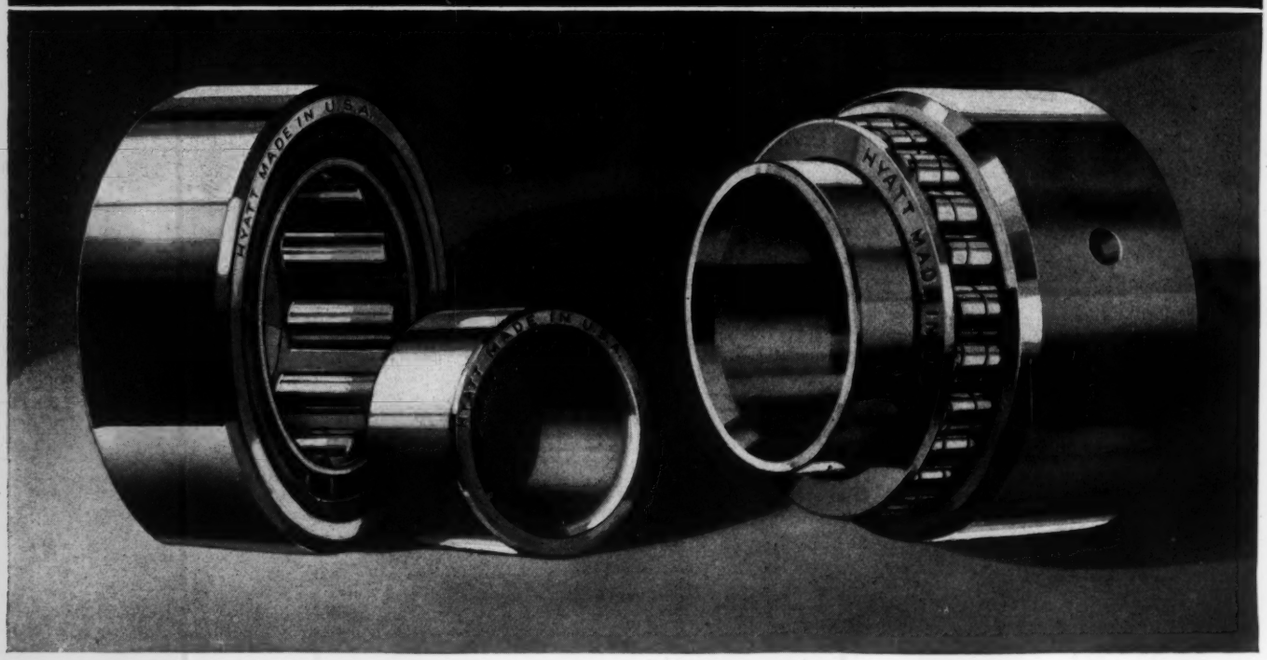

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Hidden away in mechanical equipment of all kinds, Hyatt Roller Bearings, running easily, accurately, and silently, are keeping machinery everywhere from growing old. Use Hyatts for this reason in the products you build, or look for them in the equipment you purchase. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey, and San Francisco. Hyatt Roller Bearing Sales Company, Chicago and Pittsburgh.

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Go through this book on a journey that can well put money in your pocket. Absorb a fascinating story of the work Cuno *continuously cleanable* filters are doing in your industry. See how *many ways* there are of saving time and money — by straining with Cuno. It's not a long journey, but the scenery is fine, and the fare is free if you'll use the coupon below.

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"Z" NICKEL

A New Hardenable High Nickel Alloy Combining Great Strength and Hardness with High Corrosion Resistance

Description and Uses

"Z" Nickel (98% Ni. min.) is a new corrosion resisting alloy that can be hardened by heat treatment (aging) to Rockwell C 30-45. At these hardness levels, "Z" Nickel is 2½ to 4 times stronger than structural carbon steel and has good toughness. The alloy is rustproof and corrosion resistant.

"Z" Nickel parts may be hardened after fabrication. In the unhardened or quench annealed condition "Z" Nickel fabricates almost as easily as nickel; such operations as bending, drawing, machining, and hot forging are accomplished readily.

There is little, if any, distortion of fabricated parts during hardening, as this is done at low temperature—890° to 930° F.

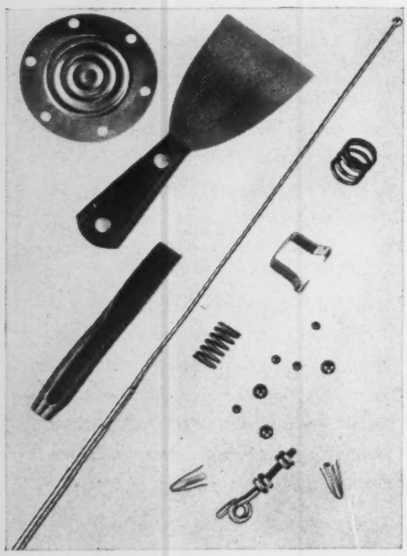
"Z" Nickel is suitable for parts that must be strong, hard, and tough like tempered steels, and at the same time rustproof and highly resistant to corrosion.

Though the alloy is new, it has been applied successfully to formed spring clips, coil springs, hand tools, wire brushes, and the like.

Available Forms

"Z" Nickel is available as hot rolled or cold drawn rods, wire, and cold rolled strip, in a wide range of sizes. These forms are furnished either hardened or soft, suitable for fabrication and subsequent hardening.

In the unhardened condition, the cold rolled or cold drawn products may be had in different tempers, according to the amount of cold work. For instance, cold rolled strip may be had in soft, half hard, or full hard temper corresponding respectively to tensile strengths, in lb. per sq. in., of 90,000 min., 130,000 min. and 155,000 min. Upon hardening, these strengths are increased 30-70,000 lb. per sq. in.

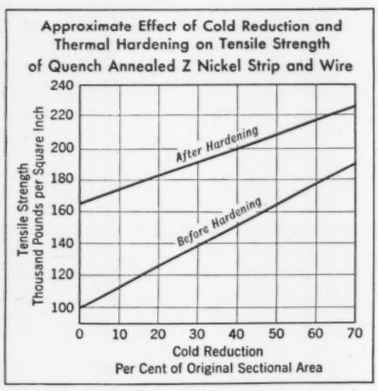


Miscellaneous "Z" Nickel parts fabricated from strip, wire or rod and heat treated. These include an automobile aerial tip, flat and coil springs, diaphragm, balls, scraper, chisel and loop with threaded shank.

Increasing Strength

As the strength and hardness developed by cold reduction or cold work is not lost during the low temperature hardening treatment, the maximum strengths and hardnesses are obtained by cold working and then heat treating.

In this manner, the hardening effect of heat treatment is superimposed on the hardening produced by cold reduction or cold work. The lower curve of the figure below shows how strength increases with cold reduction, and the upper curve indicates the increase of strength by hardening. Greater cold reductions are practical on light sections—65% on wire finished to 0.125 in. dia., 60% on 0.250 in. strip, and 10% on 2 in. dia. rods. Somewhat higher reductions than those quoted are possible in special cases.



Physical Constants

Density	8.75
Specific Gravity, lb. per cu. in.	0.316
Electrical Resistivity	
Ohms per mil-foot at 20° C. or 68° F.	84-96
Temperature coefficient	0.0036 per ° C. or 0.0020 per ° F.
Tensile Modulus of Elasticity	30,000,000
Torsional Modulus of Elasticity	11,000,000

Heat Treatment

Although quenching from 2000° F. is required to render "Z" Nickel susceptible to heat treatment, users seldom need be bothered with this as the mill supplies "Z" Nickel already quenched and suitable for fabrication of parts which can be hardened in finished or semi-finished form.

Quenching and Annealing: Quenching by the user will be necessary only when the fabricating process involves a long series of operations with intermediate anneals, which are done at 1350°-1750° F., except the final quench anneal, done from 2000° F. The heating must be done in a furnace atmosphere controlled to avoid loss of carbon from the alloy. Decarbonization is prevented in muffle type furnaces employing hydrogen or cracked ammonia atmospheres by introducing about 5% hydrocarbon gas into the atmosphere. In furnaces direct fired with city or natural gas, the gas-air mixture fed to the burners is adjusted very rich—almost rich enough to deposit carbon.

The metal should be held at 2000° F. only long enough to obtain uniform heating and then quenched immediately.

In quenching, rapid removal of heat is necessary and for this reason best results are obtained on lighter sections.

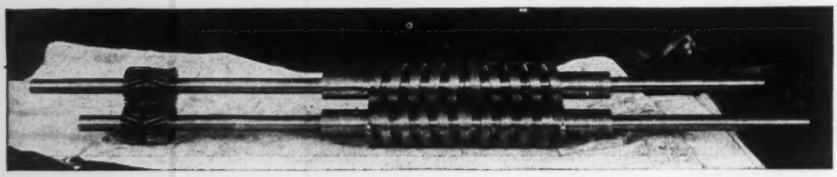
Hardening: As close temperature control (plus or minus 10° F.) is important in the thermal hardening of "Z" Nickel, the most suitable equipment is an electric furnace with automatic temperature controls.

Heavily cold worked material (usually over Rockwell C 28) such as full hard strip or spring wire is hardened by holding 6-8 hr. at 900° F. Moderately cold worked material (usually Rockwell C 18-28) such as half hard strip and "as drawn" rods is hardened by holding 6-10 hr. at 935° F. Soft material (usually under Rockwell C 18) such as annealed rods or wire is hardened by holding at 935° F. for 12-16 hr. or overnight. The slight discoloration of bright surfaces which normally occurs during hardening may be avoided by hardening the parts in an atmosphere of hydrogen which need not be dried.

The foregoing treatments are designed to accomplish hardening in the minimum time. Using modified procedures, furnished on request, hardening may be done overnight thus freeing the furnace for daytime use.

MECHANICAL PROPERTIES OF "Z" NICKEL

	Tensile Strength psi	Yield Strength (0.2% Set) psi	Elongation % in 2"	Hardness B.H.N. 3000 Kg	Hardness Rockwell "C"
HOT ROLLED RODS					
As Rolled	90–120,000	35– 65,000	50–25	150–225	.....
" " Heat Treated	160–180,000	120–140,000	20–10	300–350	.....
COLD DRAWN RODS					
As Drawn	90–150,000	50–130,000	35–15	150–300	.....
" " Heat Treated	160–190,000	120–150,000	20– 7	300–380	.....
COLD DRAWN WIRE					
Annealed	90–120,000	.....	50–25	.....	.....
" Heat Treated	160–180,000	.....	15– 7	.....	.....
Spring Temper	160–200,000	.....	5– 2	.....	.....
" " Heat Treated	200–250,000	.....	10– 5	.....	.....
COLD ROLLED STRIP					
Soft	90–120,000	.....	50–25	.....	−10 to + 10
" Heat Treated	150–190,000	.....	20–10	.....	30–40
Half Hard	130–155,000	.....	15– 3	.....	25–34
" " Heat Treated	160–210,000	.....	20– 7	.....	33–42
Full Hard	155–190,000	.....	10– 2	.....	30–40
" " Heat Treated	180–230,000	.....	15– 5	.....	36–46



"Z" Nickel is used in these screws for a screw pump handling a viscous plastic because it protects the purity of the fluid handled, has great strength and also high hardness to resist wear while operating in close contact with the housing. Manufactured by Quimby Pump Co., Newark, N. J.

Magnetic Properties

"Z" Nickel is magnetic, being similar in its characteristics to rolled nickel.

Technical Service

Our engineers will be pleased to furnish additional information regarding applications, fabrication and heat treatment of "Z" Nickel. Write us about your metal problems.

Ask us for free data sheets like this one, on: Nickel, Inconel, "K" Monel, and Monel castings.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.

REX PRESENTS

A NEW FLAT-TOP CONVEYOR CHAIN!

Here's an entirely new development in conveyor chain design—of prime interest and importance to all designers and users of bottling, capping, filling and sealing machinery! The unique No. S-815 Flat-Top Conveyor Chain, with its exclusive link and sprocket design, brings many striking advantages:

New simplicity—with no attachment rivets to work loose. The one-piece link and pin are the only parts; and the flight is made integral with the link.

Far longer life! Lower bearing pressure on the sprocket teeth makes life easier and longer for chain and sprocket. The chain pin is relieved of all loads when flexing over sprockets.

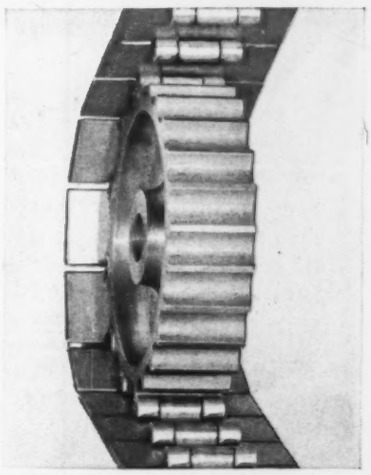
Smaller opening between links! Because of the short distance from chain top to pin center, the gap between links when flexing over sprockets is much smaller!

Easy to take apart—easy to reassemble! Links can be removed by merely taking out the pins. Removal doesn't distort the link. All links being identical, no coupler links are needed!

Easy to clean! No pockets to accumulate foreign matter. All grime and grease are easily removed by a jet of steam or water.

Fits same track as your present conventional steel flat-top chain! Replacement on present machines is a simple task. Adoption to present design means no complicated drive or track changes.

These are only some of the advantages of this new chain! Summed up, they mean that here's a chain which does a better, more dependable conveying job at lower cost—the chain for which you've been waiting! You'll want to know more about it—fill in this handy coupon—mail it to us and we'll speed full information to you at once!



Rex No. S-815 Flat-Top Chain, the "Hinge" chain built on entirely new principles of link and sprocket design.

REX DRIVE AND CONVEYOR CHAINS

CHAIN BELT COMPANY of Milwaukee

Chain Belt Company
1643 W. Bruce St., Milwaukee, Wis.

Please send me Bulletin No. 335 which contains full information on Rex Flat-Top Conveyor Chains, Exhaust Box Chains, Double-Flex Chains and Roller Chains.

Firm Name _____

By _____ *Title* _____

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Topics

ACTUAL commercial applications of the methods of making glass "invisible," developed recently, will probably be delayed until some way is found to harden the chemical film which eliminates reflection and glare of light. After that discovery, uses of the treated glass will be almost innumerable, since it will admit more than 99 per cent of light instead of about 75 per cent in the case of present ordinary glass. Basis for the announcements of both Dr. Katherine B. Blodgett, General Electric Research Laboratories, and Drs. C. Hawley Cartwright and A. Francis Turner, Massachusetts Institute of Technology, was the discovery in 1917 by Dr. Irving Langmuir, that he could make films only one molecule thick. Forty-four layers of film, amounting to only 4/1,000,000-inch thick, are built on glass by Dr. Blodgett. As light falls upon this film, rays are reflected from both upper and lower surfaces in equal intensity but opposite in phase. Thus they counteract each other and no light is reflected. In the coating operation, powder is sprinkled over a film which floats on a chemical solution in a dipping tank. The powder does not dissolve as it would in an uncovered liquid. When a piece of glass is dipped into the solution the powder-covered film adheres to it. Dipped 22 times, the glass collects two layers of film each time.

♦

ANOTHER example for the mounting list of advantages of centralized motor controls! One firm recently lost an order because the controls on its machine were not conveniently located. A competitive concern incorporated centralization of controls in the design of its machine—and won the business.

♦

IF IT had been produced in Germany, a plastic recently developed here would certainly qualify as a notable example of *Ersatz,* the practice of converting common or waste materials into products seemingly far dissimilar. The plastic, "Ferron," is converted from waste pickle liquor—sulphuric and other acids—from steel mills, and thus is also a contribution to the solution of the problem of stream pollution. Ferron is a tan-colored solid consisting largely of coprecipitated iron hydroxide and calcium sulphate, and can be molded into almost any form. It resembles wood in that it may be sawed and nailed, but it is proof against fire, termites and warping. Though somewhat like plaster it withstands higher temperatures, and weighs only one-third as much as fired clay and brick. It also has high insulating value because it holds a high proportion of entrapped air.

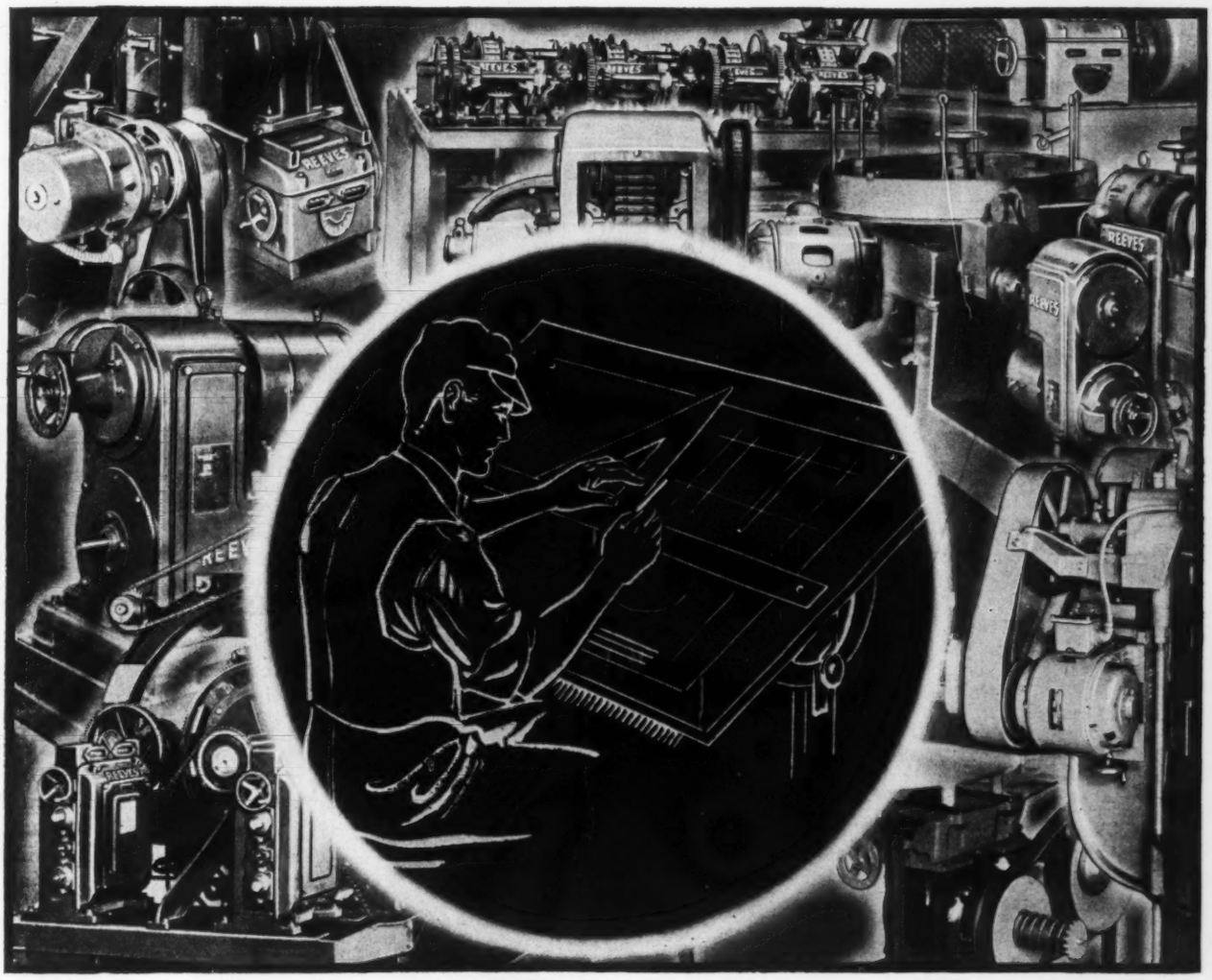
♦

TO THE article on Chrysler's fluid flywheel which headed last month's issue an additional note may now be added. When the flywheel is rotating above idling speed the blades are not completely submerged and the radial distance to the oil from the axis of the shaft is somewhat in excess of the radius of the baffle plate, designated as f in the diagram that was used. Extending into the path of the circulating liquid at low speeds, the baffle plate serves to impede the flow so that at idling speeds the car will not creep unduly when brought to a stop.

♦

BROADCASTS will begin in the spring over a radio system claimed completely to eliminate static and other extrinsic noises. Major Edwin H. Armstrong, professor of electrical engineering in Columbia university is the inventor, and the General Electric Co. already is making sets to receive initial broadcasts. Known as frequency modulation in contrast to the present term of amplitude modulation, the new system brings about wave frequency changes with the fluctuation of the voice and is not governed by the intensity of radiation. In effect, a new characteristic not in waves produced naturally has been injected into the radio wave. The receiving sets will respond to this special characteristic and not to any characteristic in natural waves. It will be possible, however, to receive present programs with the new sets. An experimental station built in the woods near Alpine, N. J., has, instead of the customary antenna strung between supports, a 400-foot tower and three 150-foot cross-arms from which a series of copper-plated steel bars extend, fastened to a boom suspended between

(*Concluded on Page* 86)



BUILDERS OF 1325 DIFFERENT MAKES OF MACHINES CAN'T BE WRONG . . .

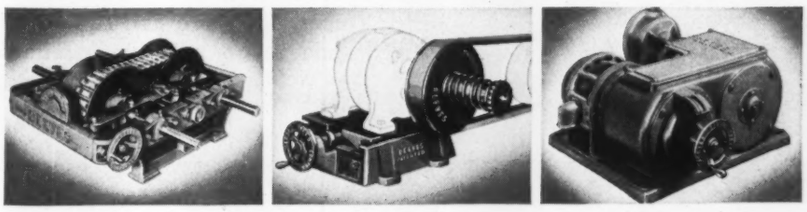
When you find builders of 1325 different kinds of machines—used in every industry—adopting a given make of speed control equipment, you can't go wrong on that equipment for your own needs.

REEVES units—Transmission, Vari-Speed Motor Pulley and Motodrive—are the only speed control equipment in the world with such an overwhelming endorsement. Builders of these hundreds of machines have standardized on REEVES to give the speed flexibility which their customers demand to insure maximum productive efficiency under every changing operating condition.

You can give the machines you build the proved sales advantages of REEVES Speed Control at extremely reasonable cost. A wide range of designs, sizes, speed ratios and controls from which to choose the correct application for your individual requirements.

Let our engineers show you how it can be done. You are probably in or near one of the 33 industrial centers of the U. S. and Canada where REEVES engineering service is quickly available. Write today for the name and address of your nearest REEVES representative and for our new catalog G-384, describing the complete REEVES line.

REEVES PULLEY COMPANY, Dept. H29, Columbus, Indiana.



THE 3 BASIC UNITS IN MODERN REEVES LINE

REEVES
• accurate
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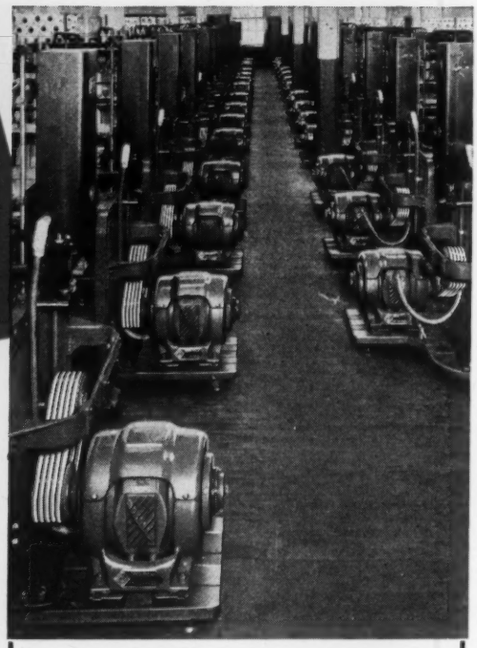
SPEED CONTROL

HOW A DRIVE REVOLUTIONIZED AN INDUSTRY!

...a true case history from the Allis-Chalmers files that proves **"IT PAYS TO BUY THE EQUIPMENT THAT PAYS FOR ITSELF!"**

Read the Amazing Story of How the Texrope Drive Cut Average Drive Maintenance Costs on Spinning Frames to $1.05 per Year . . . Saved Thousands of Dollars in the Textile Industry! Find out How Allis-Chalmers Equipment . . . the Equipment that Pays for Itself . . . Can Save You Money!



DRIVING SPINNING FRAMES in a large southern textile mill are these Allis-Chalmers "Quick-Clean" Motors and Texrope Drives.

● They brought a tough job to Allis-Chalmers . . . those engineers from a large southern textile mill. They had trouble . . . plenty of it. They had drives that slipped or jerked, snapping fragile yarn on spinning frames . . . spattering oil on processed goods.

Production costs were running rampant. Spinning frames had to be stopped while repairs were made . . . while broken threads were re-tied. Oil-damaged goods had to be sold for a fraction of their actual cost . . . far below standard market values.

They came to Allis-Chalmers. And no wonder! For they knew that Allis-Chalmers, with an engineering background extending over half a century, could help them. Allis-Chalmers did help them . . . and in doing so, revolutionized an entire industry!

For out of this engineering problem came the Texrope Drive. And because the Texrope Drive did not slip . . . did not jerk . . . did not break the yarn on the frames, production costs were cut to an absolute minimum throughout the textile industry. Actually, drive maintenance costs on spinning frames were reduced to the sensationally low average of $1.05 per year!

From the Textile Industry to All Industry!

All this happened in the 1920's. And today throughout all industry . . . all over the world . . . the Texrope Drive is setting amazing records in cutting costs, in beating power waste. Texrope Drives have paid for themselves, hundreds of times over, wherever they are installed!

This true case history is not an unusual occurrence at Allis-Chalmers. It's another engineering solution to the constant problems that confront industry . . . another noteworthy addition to the Allis-Chalmers line of equipment that pays for itself.

Get the complete details on the way Allis-Chalmers can put 90 years of engineering experience to work for you. Get the facts. In the District Office near you, there's an Allis-Chalmers engineer who can show you how to make your plant a bigger money-maker . . . with the equipment that pays for itself!

973

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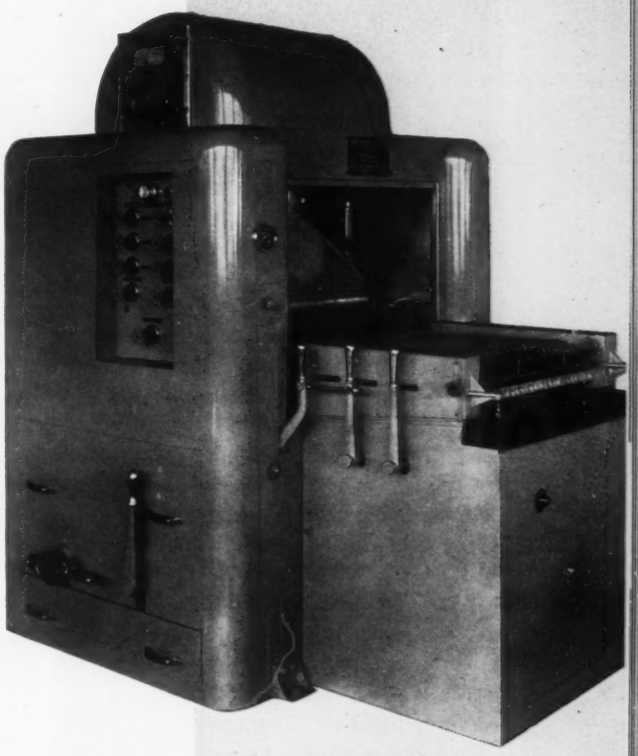
TEXROPE DIVISION

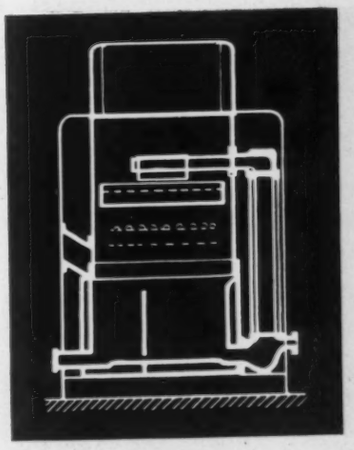
ALLIS-CHALMERS

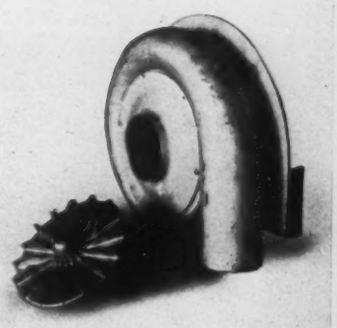
MILWAUKEE·WISCONSIN

MACHINE DESIGN

Temperature Control Is Basis for Candy Machine







By Thomas Flint
J. W. Greer Co.

IN DESIGNING a chocolate coating machine one of the primary considerations is to provide for rigid temperature control. Without this it would be impossible to handle the chocolate economically and consistently, or to maintain a uniform coating that would "set" with a high and lasting gloss. This and many other design considerations entered into the development of the particular machine under discussion, *Fig.* 1, including the incorporation of "styling," ease of operation and maintenance, facilities for keeping clean, and mechanical sturdiness.

Chocolate heated to the proper temperature is introduced into one compartment of a double water-jacketed tank in the bottom of the machine. It flows by gravity from this compartment into a cooler "tempering" compartment where some of the heat of crystallization is removed, and thence is pumped through a vertical riser to the necessary height for distribution over the candy centers to be coated. Both pump and riser are jacketed, and the temperature of the jacket water is automatically maintained by means of an indicating temperature con-

Fig. 1—Top—Chocolate coating machine showing in-built steam and water control panel. Fig. 2—Center—Schematic diagram of unit. Fig. 3—Right — Water pump rotor and centrifugal blower casing

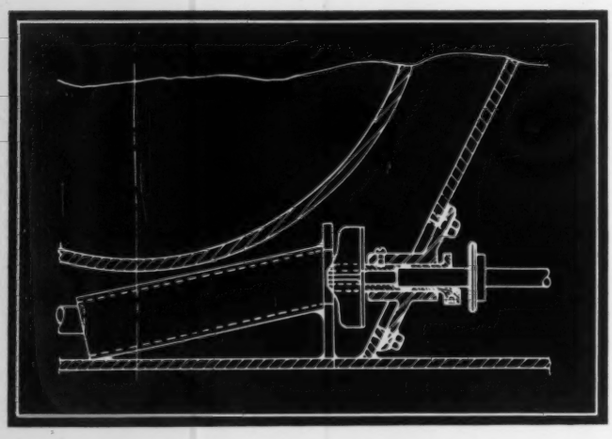


Fig. 4—Water is drawn through pipe and distributed in surrounding jacket water

trol whose active element is located in the chocolate just before it is applied.

The product to be coated is carried through two falling curtains of the chocolate on a coarse mesh wire belt, after which it is subjected to a powerful blast of air to remove surplus coating, and then shaken to remove ripples formed when blowing. Accurate control of the weight of coating is maintained by regulating the amount of air blast and "shake."

Two of the problems solved in connection with the warming up and revitalizing of unused chocolate were (1) that of circulating the jacket water in the tanks without an elaborate pumping set up, and (2) that of developing a blower to deliver about 1000 cubic feet per minute of air at 12-inch water pressure. *Fig.* 4 shows how the first problem was solved. A simple centrifugal pump rotor, shown also in *Fig.* 3, draws water through a pipe from the far side of the tank and allows it to escape into the surrounding jacket water. Development of a centrifugal air pump capable of fulfilling the requirements with an input of only three horsepower resulted in the blower shown in *Fig.* 3.

The most troublesome characteristic of chocolate when handled near its freezing point is its tendency to solidify suddenly with the slightest drop in temperature. This results in stoppage of pipes, breakage of

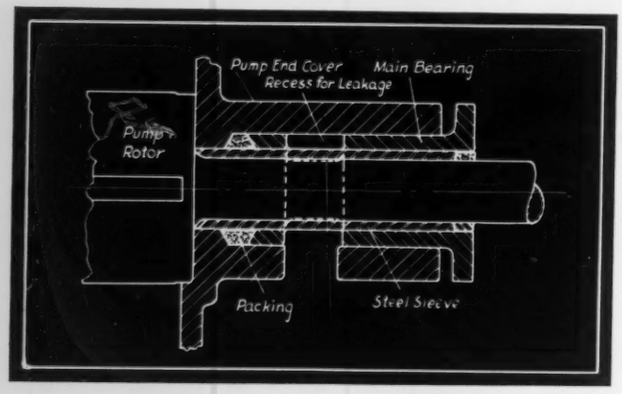


Fig. 5—Simple packing and recess prevent sugary mixture from entering main bearing

agitators, and the building up of chocolate on any cold surface. Difficulty in this connection was almost entirely eliminated by using a double-walled construction with the air between warmed with electric heaters.

Another difficulty inherent in the handling of any sugary mixture is the tendency of the sugar to carbonize in bearings and quickly destroy the bearing surfaces. The solution for this is to supply a simple packing (see *Fig.* 5) around the shaft in question without, however, allowing the shaft to touch anything but the packing. Entirely separate from the packing glands, and outside of them, is the shaft bearing, so that any leakage getting past the packing will simply fall rather than be forced into the bearing.

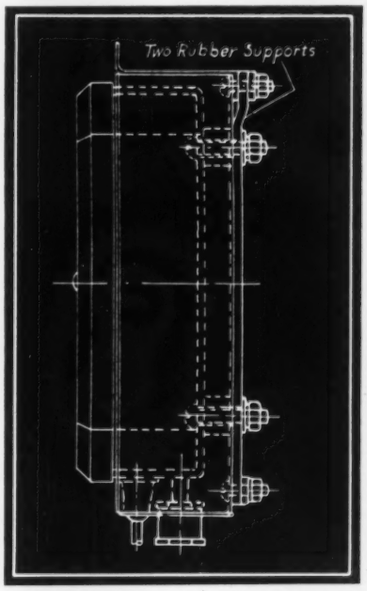


Fig. 6—Thermometer is mounted on two tightly-stretched rubber supports to dampen vibration

Aside from the obvious expedient of making all parts strong enough several devices were developed to protect parts that might be broken due to running while "frozen up"; or in the case of the indicating thermometer, from vibration. Protection from breakage due to freezing of chocolate while running was effected simply by providing shear hubs and pins at key points in the drive. These are calculated to shear well below the danger point for any part in the machine.

Rubber Mounting Is Used

Many spring mountings and rubber cushions were tried before the shock absorbing thermometer mounting shown in *Fig.* 6 was developed. This simple arrangement has proved entirely successful under conditions far worse than those encountered in its present application. It should be noted that the rubber is in shear as well as tension and compression. All bearings are lined with bushings of the type using a porous metallic compound which holds by capillary attraction enough lubricant to maintain the bearing for a long time. This feature, combined with the previously de-

(*Concluded on Page* 40)

Scanning THE FIELD FOR Ideas

Ball-Nut Improves Steering Gear

A NEW compact design of steering gear combining high efficiency, long life, and freedom from backlash makes use of steel balls for rolling motion between the helical screw and nut. Efficiencies as high as 98 per cent under working loads have been obtained with this design. The gear, *Fig.* 1, consists of a screw or worm with a helically-ground concave groove running within a nut with a similar groove, the grooves being filled with steel balls. A ball-return U-shaped tube transfers the balls from one end of the nut to the other to provide a continuous rolling path for the balls.

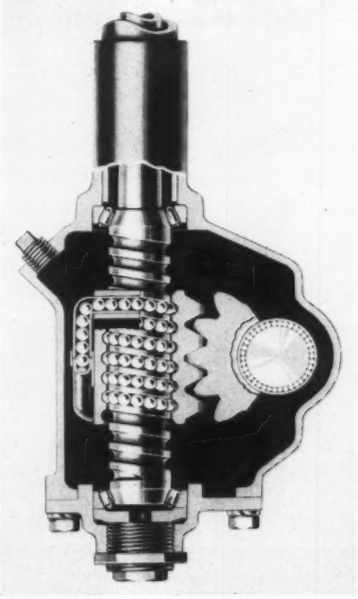


Fig. 1 — Ball-nut gear provides rolling motion between hardened and ground helical screw and nut

Provision is made in the design for strength and serviceability. However, should a ball break and jam in service the gear becomes a worm and nut drive with sliding motion, but it remains safe for use. The gear is made by the Saginaw Steering Gear division, General Motors Corp.

Development of the foregoing unit brings to mind another device employing steel balls *M. D.* Dec. 1937, page 60) in which five streams of balls transmit power from a helical screw to a threaded enclosing drum, effecting a speed reduction of 36 to 1. In this instance the balls travel in a path corresponding to the axis of the screw rather than around its periphery.

Nonforceable Valve Prevents Breakage

PROTECTED against breakage by forced closing this new valve, designed by the George Valve Co., also provides for a clean valve face and seat to insure proper closing. Prevalence of failures in conventional valves due to corrosion, freezing or foreign matter on the seat has led to this new design.

The operation of the valve is illustrated in *Fig.* 2 which shows the closed position. When open, two oil-

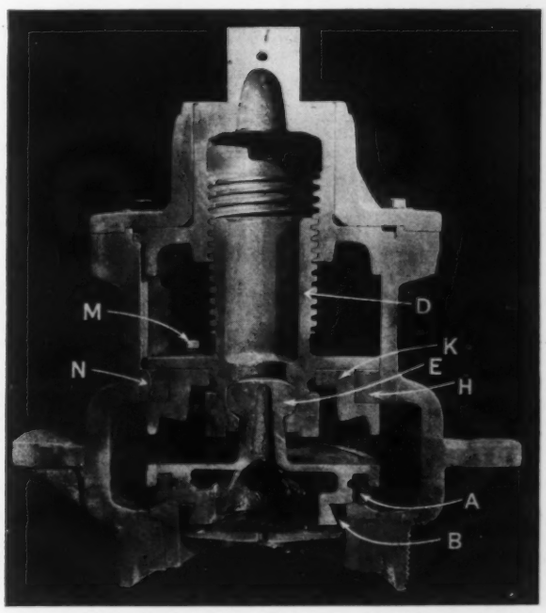


Fig. 2—Nonforceable valve has compression seating and free-wheeling features. Parts A and B are rings for cleaning valve seat, D thread for closing valve, E ball joint, K friction part, H friction ring, N key, M friction adjustment screw

resisting chloroprene rubber rings spring to normal unstressed position and completely enclose the valve face preventing any foreign substance from becoming lodged. On closing, both rings wipe across the valve seat and clean it of scale and dirt. Compression seating and a free-wheeling action eliminate possible scoring of the valve face.

Opening and closing is accomplished by rotating the valve stem which raises or lowers the valve face through cooperating threads. The inside assembly is kept from rotating by the friction of the parts on a metal ring. This ring is held by a key but can slide up and down in housing. The friction between the inside assembly and the ring is predetermined and can be regulated by a screw.

Should a workman continue to turn the valve after it has become seated a ball joint prevents the valve face from turning. The cooperating threads do not extend further after the turning force exceeds the friction between the keyed ring and assembly. Further turning will not seat the valve any tighter thus precluding the possibility of breakage.

Granulated Melt Covers Welding Arc

AUTOMATIC production welding particularly suitable for heavy materials and long welds employs a new process involving a special welding head to feed bare welding rod and a granulated material, "Unionmelt," to the work. High welding currents with high speeds and efficiencies are obtained in welding steel from 16 gage to 3 inches in a single pass at speeds ranging from 3 to 80 inches a minute.

In the process, developed by the Linde Air Products

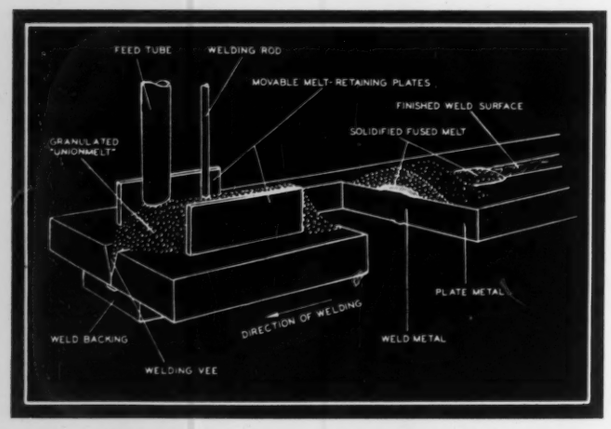


Fig. 3—Welding arrangement showing method of covering arc with melt material

Co., the electrode end and arc are covered completely by the granulated melt. Although highly resistant when cold, the melt conducts electricity in the molten state. To start the weld a fuse such as a ball of steel wool is used. Generated heat then continues to keep the melt in a molten state and the entire welding action takes place beneath this blanket without visible arc, sparks, spatter, smoke or flash as shown in *Fig.* 3.

The welding composition makes possible the use of higher current densities producing rapid generation

Fig. 4—Facsimile bulletin receiver for home use

of intense heat at the weld. In addition to excluding atmospheric and other gases it acts as a cleanser, washing the metal which melts from the rod and absorbing impurities from the fused base metal. As the weld cools the composition becomes a glass-like slag which cracks off in relatively long pieces.

Either alternating or direct current may be used or direct current superimposed upon alternating current. Current values up to 4000 amperes may be applied. The speed of the welding wire feed is governed by automatic electric controls preset by the operator and determined by the rate of welding.

Facsimile Broadcasts for Homes

DEVELOPMENT of equipment suitable for producing facsimile news bulletins is now at the point where transmission is satisfactory, though over a limited area. Soon we may have up-to-the-minute illustrated news at our breakfast table. Experimental programs similar to television field tests now being conducted will provide data on technical requirements for transmitting and receiving equipment.

Suitable for homes because of its relatively simple operation the RCA Victor receiver-printer, *Fig.* 4, is no larger than a table model radio. Once the con-

trols have been adjusted no further attendance is required, the facsimile bulletins flowing continuously through a slit. Width of the paper roll is 8½ inches and printing is at the rate of three 8½ x 12-inch pages an hour.

Pictures, drawings or text for transmission are placed on the "scanner" of a transmitter. A beam of light travels horizontally across the page as the scanner revolves. Reflected light in the various degrees of shading corresponding to the picture is focused on a photoelectric tube, transforming the light into impulses which are flashed through the air.

The receiver is synchronized with the transmitter picking up signals exactly as in sound broadcasting. Instead of passing through the loud speaker the signals actuate the printing mechanism. Fluctuations in the intensity of incoming signals press paper and carbon transfer paper together against a single spiral of wire to make marks corresponding to the original as the paper and carbon feed continuously over a metal drum.

"Cleanlining" Household Machinery

CONCEALED when not in use the built-in switches of the Westinghouse ironer in *Fig.* 5 enable the panel in which they are mounted to be flush, thus enhancing the appearance of the machine. Conveniently located, yet out of the way of all ironing operations, the heat and motor switches with pilot light are mounted in a control box which tilts forward wnen the indentation on the panel is pressed. Closing the box automatically turns off the current.

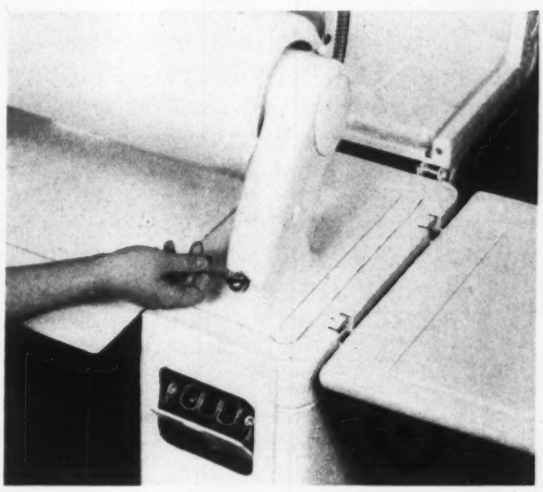


Fig. 5—Tilt panel conceals switches when closed

This safety feature precludes any possibility of unintentionally leaving the heating elements or motor connected. The closed panel in addition to improving the appearance of the unit gives visual indication that all power is disconnected. Also it protects the switches from accidental damage and provides an easily-cleaned smooth surface.

Hydraulic Punches for Group Use

INDIVIDUAL punching and stripping units mounted in a fixture for multiple operation permit ready rearrangement to suit design changes with little salvage loss. *Fig.* 6 illustrates such a combination of twenty units for punching thirty-six holes, some punches being double. The units, designed by Progressive Welder Co., involve a combination of hydraulic pressure with spring action.

Reference to the illustration shows the design of one of the smaller single punch units. Compact, it operates by admitting low pressure to move both punch and stripping shoulder up to the work at which point the resulting back pressure trips a switch which initiates the necessary high pressure to drive the punch through the work.

When pressure at the pressure chamber is relieved, the punch is withdrawn by the action of the stripping spring, shown coiled around the punch. This spring acts against both the punch retainer and the piston guide, the latter being firmly held in place until stripping is completed. When compression on the stripping spring approximates that of the piston spring, the latter moves the piston guide away from the work and to the starting position.

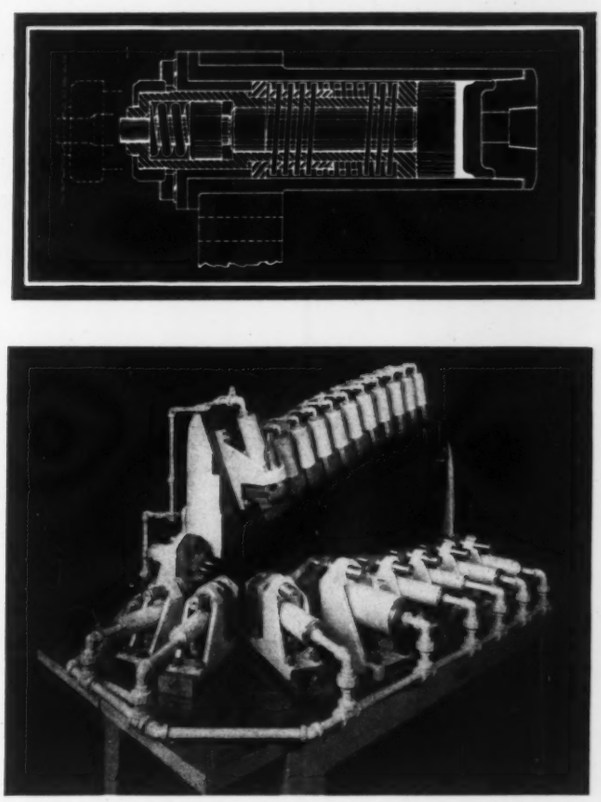


Fig. 6—Hydraulic punch units arranged for multiple operation

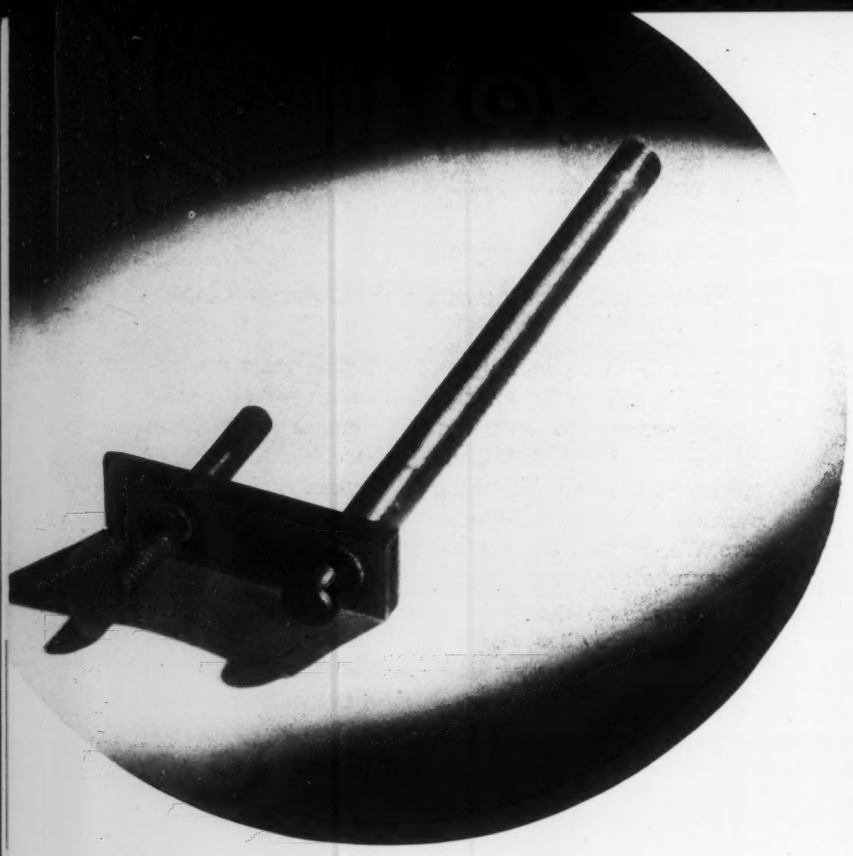


Fig. 1—Assembly of two pins in a steel bar. Strength of this part was increased three times by brazing

Building Up M from Strip Metal

By P. E. Henninger
Westinghouse Electric & Mfg. Co.

MANY successful applications of parts built up from strip steel laminations or standard bars and rods have been made within recent years. Such parts can readily be fabricated by current production methods. The brazing of laminations of blanks made by punch and die, or of assembled machined parts, is replacing conventional methods for many designs. Often where production does not warrant punch and die methods the laminations are burned out with an oxy-acetylene torch.

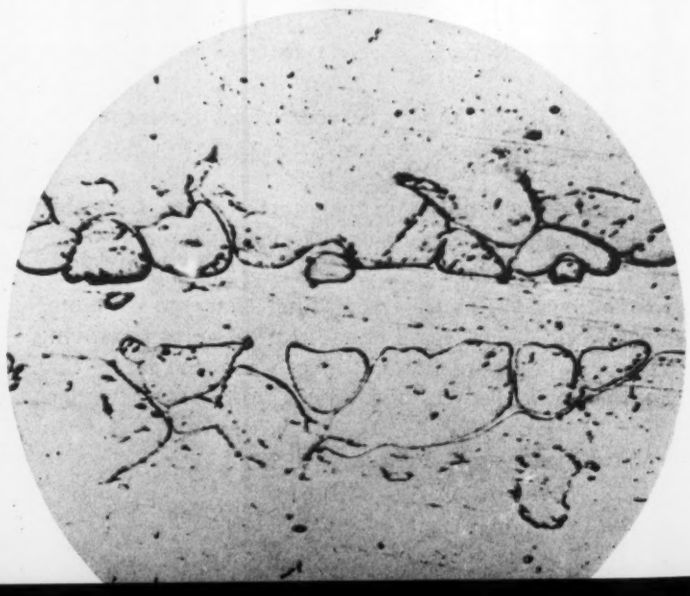
Various designs with inaccessible joints or intricate assemblies which hitherto have been difficult to produce are now practicable by furnace brazing. Where high unit activity or numerous joints per unit are required, brazing may replace castings, forgings, machining, riveting, spot welding, torch-brazing, and hand soldering. Furnace brazing methods produce strong, gas-tight and neat appearing joints.

Materials Easily Brazed

Built-up parts are resistant to vibration and impact and free from localized stresses. Some of the representative materials which can be brazed easily include steels, steel castings, copper, silver, bronze, nickel and monel. Materials more difficult to join are high chromium or high chromium nickel alloys, aluminum, nitralloy, cast iron and zinc bearing alloys.

Characteristics of bond-holding properties of brazed laminated material are shown in *Fig.* 3. The purpose of the illustration is not to indicate the design of the part, but to evidence the quality of structure as shown by the unsuccessful atempts to separate the laminations. The reason for the strength of the joints is that the bond between the laminations is alloyed with the steel, and the joints are as strong or stronger than the material itself. *Fig.* 2 shows this bond at high magnification (x300) and illustrates the diffusion of

Fig. 2—Bond between laminations shown at x300 magnification



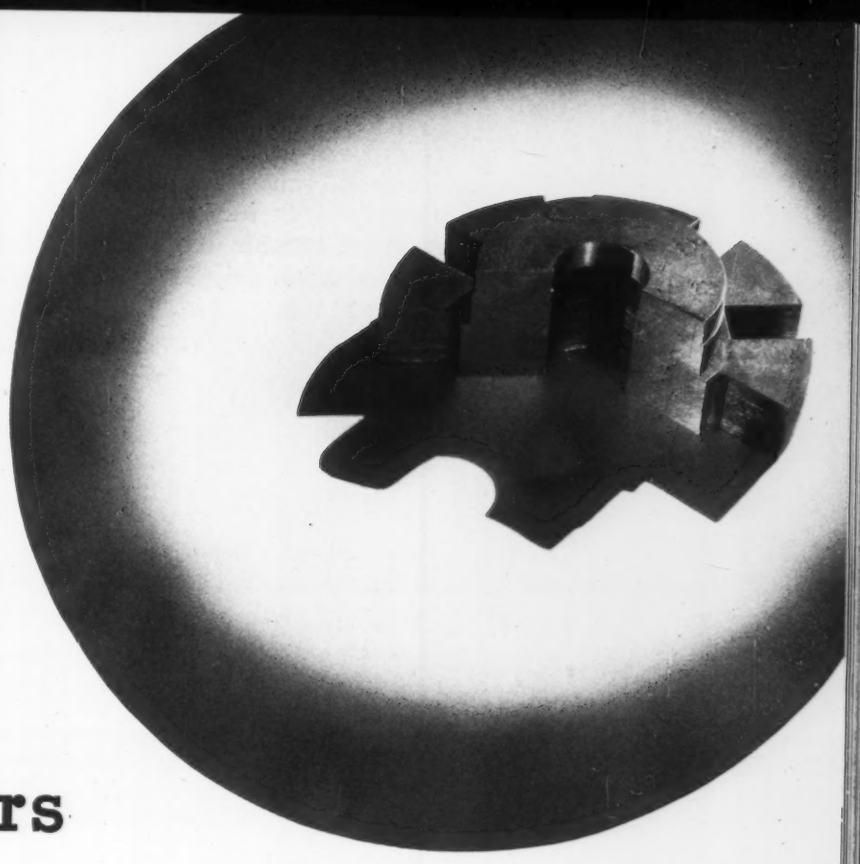


Fig. 4—Cutaway view of large coupling made from stampings. Parts were held to fine tolerance, eliminating machining

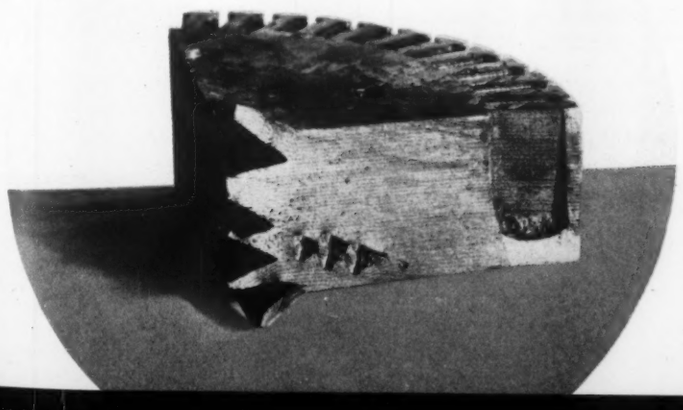
Up Machine Parts

ta and Standard Bars

the copper with the steel along grain boundaries.

An assembly of two pins in a steel plate is shown in *Fig.* 1. Formerly these parts were torch brazed with silver solder. With the furnace brazing method, a three-fold increase in strength and a substantial cost reduction are obtained. In contrast to brazing of assemblies of laminations, the outstanding feature shown here is that the bonding has only small contact areas, whereas laminated structures may have bond areas twelve or fourteen inches in diameter. In the parts illustrated, rods of one-fourth inch and three-eighths inch in diameter have contact areas of .1963 square inch and .2960 square inch respectively in a bar one-fourth inch thick. Yet in spite of such small areas of contact, pressures of 10.19 tons per square inch and 13.51 tons per square inch respectively were required to break the joints.

Fig. 3—Section of a laminated brazed part, after testing



A section of a brazed coupling made of punched laminations each one-sixteenth inch thick is shown in *Fig.* 4. This item was previously cast and required machining all over. Dimensional tolerances of the part are .005-inch thereby eliminating all machining on the brazed design except for bore and keyway. For these operations, only enough stock is left to permit grinding bore and cutting keyway to size. Thus savings are made by not having to mill the slots around the periphery.

Many Applications For Brazing

Another application of the holding properties of brazing is brought out in *Fig.* 5. In this case 44 laminations, each one-sixteenth inch thick, were brazed together. Attempts were made on a hydraulic press to separate the laminations without success. Evidence of the severe pressure exerted can be seen in the distortion of the holes.

Fig. 6 represents another shape and still another method of obtaining a construction by brazing with evidence of considerable machining savings. For the

purpose of illustrating the ease and economy possible by this method of manufacture, consider machining the inserts and burning out the body with an oxy-acetylene torch. After pressing together the parts shown in the drawing, and attaching the brazing

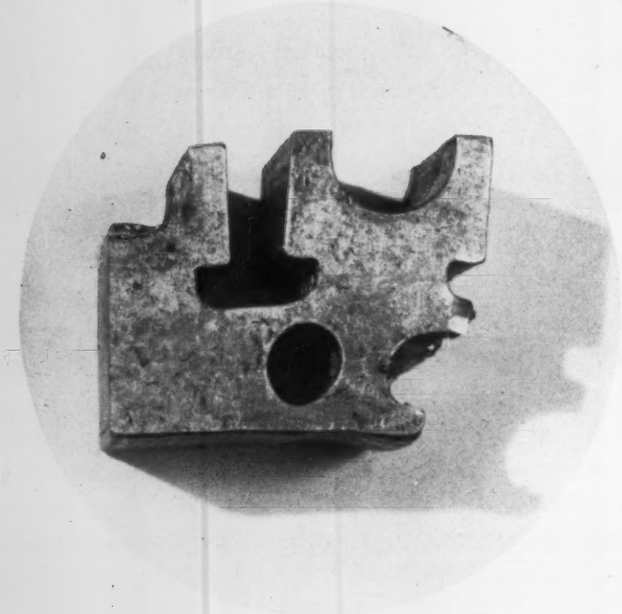


Fig. 5—Laminated section after testing joints on a hydraulic press

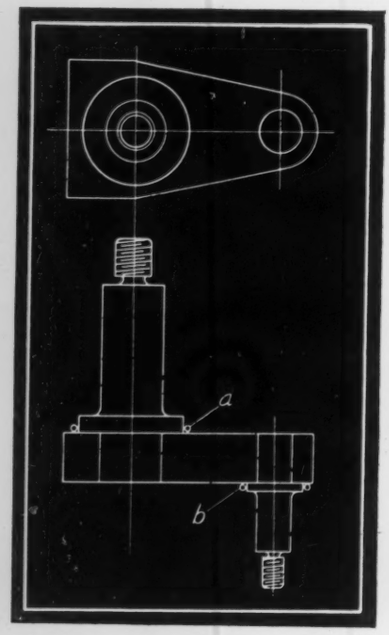


Fig. 6—Method of brazing crank assembly. Both *a* and *b* indicate brazing wires

wires, the assembly is passed through the furnace in the usual manner.

Fig. 7 is a part which presents no difficulty in producing by the brazing method. Two pieces of bar stock are machined as shown. The shoulder of the one piece is a press fit in the other, leaving the slot

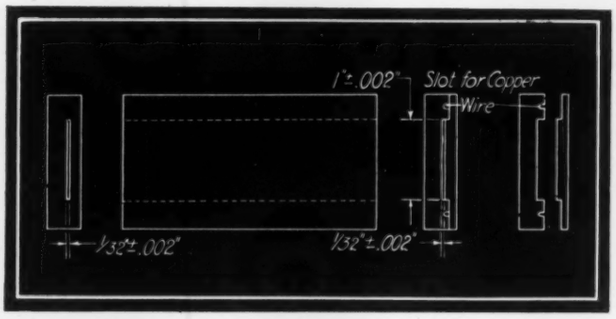


Fig. 7—Brazing method used to produce narrow slot

as illustrated. Grooves in one of the parts receive the copper wire for brazing.

Economies effected by this method of manufacture vary with the amount of machining eliminated. Actual cases similar to those described have shown that savings range from 20 to 300 per cent.

Eliminating Surface Wear with Superfinish

CHRYSLER CORP.'s Superfinish has been well publicized since its announcement late last year, but a great deal of haziness still surrounds its actual nature. D. A. Wallace, its inventor and president of the Chrysler division, says it "may be defined as an extremely fine crystalline surface finish produced upon flat, round, concave, convex and other types of surfaces, either external or internal. It is achieved by a combination of short motions, light abrasive pressure, slow abrasive cutting speeds, hard abrasive stones and a lubricant of proper viscosity to eliminate the amorphous scratches and surface defects created by previous mechanical operations, without causing new scratches and defects in the Superfinished surface.

Three motions are always necessary and five or more are desirable in producing Superfinish. Some equipment in use—the numerous applications of the finish require many different machines—has as many as ten motions operating simultaneously. The latest Superfinishers have a variable multimotion action that allows the abrasive to bring the metallic surface to crystalline smoothness.

Surface defects of previous mechanical operations are removed by Superfinishing to the point where only base metal is left. Any scratches remaining are below the bearing surface. Hence two Superfinished surfaces, in conjunction with each other and properly lubricated will show scarcely any wear. Scratches, being below the bearing surface, act as reservoirs of lubricant. Defects in other types of finish, since they protrude above the level of base metal, contribute to rupture of the oil film under pressure and thus permit metallic contact. Heat is then increased through abrasion and wear results.

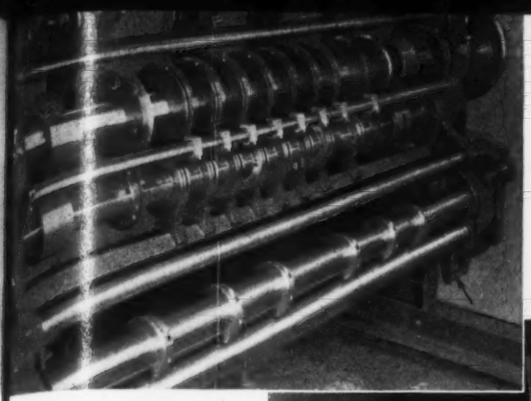


Fig. 1—Left—Corrugated box partition slotting machine with creaser shafts lowered. Fig. 2—Below—Same machine with creasing shafts in working position

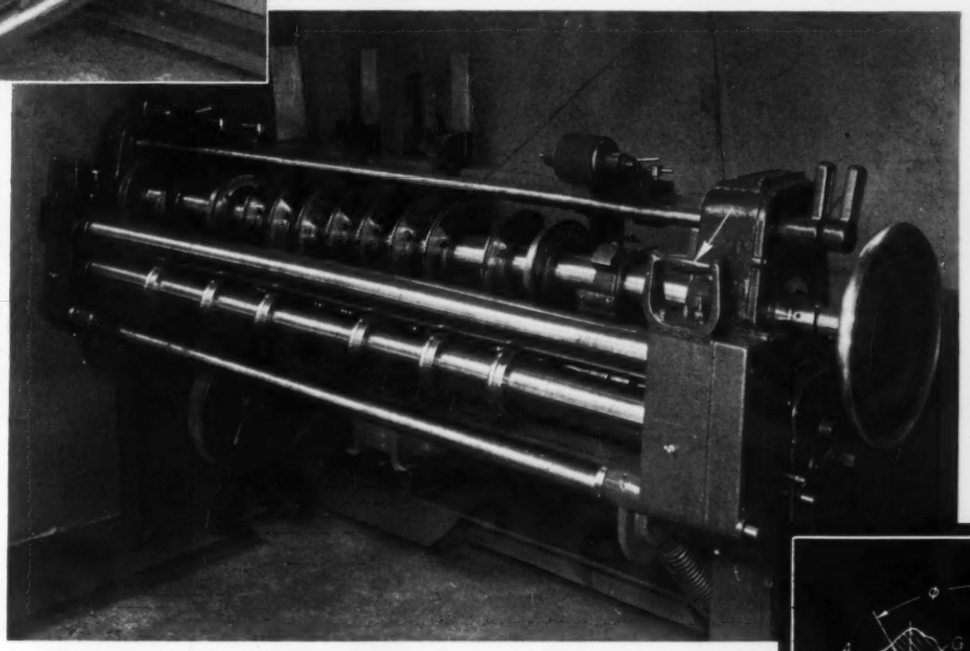


Fig. 3—Below, right—Principle of balancing by means of compression spring. This is utilized in machines illustrated, balanced mass being indicated by arrow

Spring Balancing of Hinged Masses

By J. J. Pesqueira

WHERE IT IS not desirable to use counterweights to balance hinged masses because of lack of space or other similarly precluding reasons, a suitable arrangement of balancing springs can be employed. Recourse also can be made to spring balancing when an undesirable increase in weight in a machine (such as a portable machine) would result from the presence of heavy counterweights, or if the counterweights would spoil the appearance of that machine. Powerful springs are much easier to conceal, and much lighter, than large swinging counterweights.

The balancing of hinged masses by springs, such as illustrated in *Figs.* 1 and 2, may be *partial* or *complete*. If the mass to be balanced is not large, partial balancing may be sufficient for direct manual operation. Otherwise, complete balancing might be necessary. These two methods of balancing are discussed in the following.

PARTIAL BALANCING. Let A, in *Fig.* 3, be the mass to be balanced, O its center of rotation, and G its center of gravity. Let S be a compression spring pivoted at P and acting on the end Q of the crank OQ attached to the mass system, and so disposed that the line of action or axis of spring S passes through O when OG is vertical. If ϕ is the angular displacment of OG

from the vertical line, the moment M_w produced by gravity acting on the mass A is

$$M_w = W R_1 \sin \phi \quad \ldots\ldots (1)$$

where W is the weight of A, and R_1 the distance OG. On the other hand, the spring S will exert a moment M_s opposing M_w and having the value

$$M_s = F R_2 \sin \phi \quad \ldots\ldots (2)$$

where F is the value of the variable spring force at the point ϕ, and R_2 is the radius OQ of the spring crank.

This value of M_s is only approximate because of the angle ϵ which PQ makes with PO. However, since PQ is usually large with respect to OQ, ϵ may be considered small enough to have practically negligible effects. If F_o is the mean force of spring S, that is, its force when $\phi = 90$ degrees, and C the spring constant or rate (the force in pounds per inch of deflection), then $F = F_o - R_2 C \cos \phi$, and hence Equation (2) may be written

$$M_s = F_o R_2 \sin \phi - R_2^2 C \sin \phi \cos \phi$$
$$= F_o R_2 \sin \phi - \tfrac{1}{2} R_2^2 C \sin 2\phi \quad \ldots\ldots (3)$$

The difference between the gravity moment and the spring moment is

$$M_w - M_s = (W R_1 - F_o R_2) \sin \phi + \tfrac{1}{2} R_2^2 C \sin 2\phi \ldots (4)$$

If the mass is to be balanced against gravity when

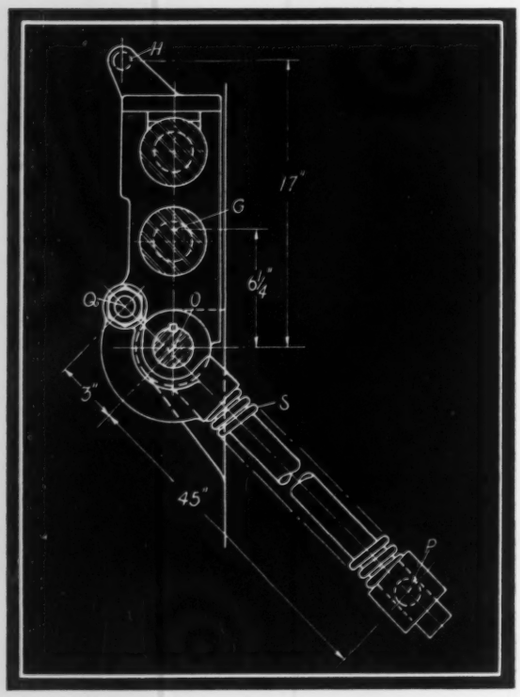


Fig. 4—Actual application of principle in which two swinging shafts are lowered

the moment M_w is greatest, that is, when OG is horizontal ($\phi = 90$ degrees), in which case, $\sin \phi = 1$ and $\sin 2\phi = 0$, Equation (4) will give, setting it to zero,

$$M_w - M_s = W R_1 - F_o R_2 = 0$$

or

$$F_o = W \frac{R_1}{R_2} \quad \ldots\ldots (5)$$

from which the required mean force of the spring may be computed. The forces of the spring at $\phi = 0$ and $\phi = 180$ degrees will be $F_o - R_2 C$ and $F_o + R_2 C$, respectively. In view of Equation (5), Equation (4) becomes simply

$$M_w - M_s = \tfrac{1}{2} R_2^2 C \sin 2\phi \quad \ldots\ldots (4')$$

This result represents a residual moment tending to produce rotation in the sense effected by gravity between $\phi = 0$ and $\phi = 90$ degrees, and opposite to this between $\phi = 90$ degrees and $\phi = 180$ degrees, being zero at the points $\phi = 0$, 90 degrees and 180 degrees, and having maximum numerical values equal to $\tfrac{1}{2} R_2^2 C$ at the points $\phi = 45$ degrees and $\phi = 135$ degrees. Clearly, then, the tendency of the spring is to keep OG horizontal. The maximum numerical values of the residual moment may be large or small, depending on the values chosen for R_2 and C.

In endeavoring to keep these maximum values small, it should be borne in mind that a reduction in the value of R_2 implies, according to Equation (5), an increase in the value of F_o, whereas a reduction in the value of C will in general increase the length of the spring. Larger values of F_o give rise to increased friction at the pivot bearings. Space permitting, however, best results are obtained with C small by the use of long springs with a great number of turns.

Although a compression spring was specifically considered in the foregoing, it is hardly necessary to say that an extension spring would have served the purpose with exactly the same results. In this case, either the line PO or the crank OQ would have been completely reversed. Again, the balancing conditions in the interval of rotation $\phi = 0$ to $\phi = 180$ degrees clearly exist in similar manner in the interval $\phi = 180$ degrees to $\phi = 360$ degrees, the analysis being thus valid throughout a complete revolution of A.

Balancing of Swinging Bearings

As an example of application of the above method of spring balancing, an actual design case will be presented (see *Figs.* 1 and 2). It was required to balance a pair of swinging bearings carrying two heavy shafts. These were to be swung as one with ease and quickness by hand, from an upper vertical position to a lower vertical position. The two bearings were keyed to a shaft O (*Fig.* 4), which served also as a pivot shaft engaging bearings on the side frames of a machine. The balancing burden was divided between two compression springs concealed within the side frames of the machine, one acting directly on each of the swinging bearings. Total weight of the swinging mass was 527 pounds, its center of gravity

being 6.25 inches from the axis of rotation O, and the radius of the spring crank 3 inches. Mean force for each spring was found to be, by Equation (5),

$$F_o = \frac{527}{2} \times \frac{6.25}{3} = 549 \text{ pounds}$$

Distance from O to P was made as large as the side frames allowed, so that the springs would be as long as possible. The springs were made of 94 active turns of 5/16-inch round steel wire, the mean diameter of the coils being 2 inches. The rate was 20 pounds per inch of deflection per spring, the two having a combined rate of 40 pounds per inch of deflection. Therefore the maximum numerical value of the residual moment was, by Equation (4′) for $\phi = 45$ degrees or 135 degrees,

$$(M_w - M_s)max = 2 \times \tfrac{1}{2} \times 3^2 \times 20 = 180 \text{ inch-pounds}$$

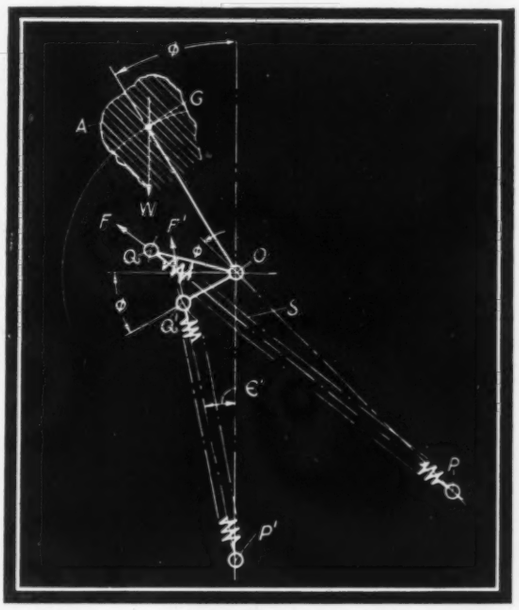


Fig. 5—Secondary springs are utilized in this instance to effect complete balancing

Handle H for swinging the mass by hand being 17 inches from O, it required only 180/17 = 10.6 pounds of hand effort to oppose and overcome the residual moments at the points of maximum values, respectively, disregarding friction. Friction was evidently small, however, since, by displacing the mass somewhat from its uppermost position, it dropped on its own accord, performing a few oscillations about its mean (horizontal) position. To eliminate instability at the upper and lower positions, the line of action PQ of the spring was made to pass a little below O when OG was vertical upwards, and hence a little above this axis when OG was vertical downwards. This condition produced small turning moments tending to keep the bearing against the edges of the side frames in either position; a "snap action" was thus attained.

COMPLETE BALANCING. If the swinging mass is so large that it will require very powerful springs to balance it by *primary* springs alone, that is, by the arrangement of springs considered in partial balancing, the residual moment will in general be too large to be overcome by direct manual operation. In this case the introduction of *secondary* springs will be necessary. The residual moment may thus be completely eliminated, as shown below.

Secondary Spring Aids Balancing

In *Fig.* 5, let a compression spring S' be made to produce a turning moment on A in the same sense as that exerted by the primary spring S for $\phi < 90$ degrees. Let S' be pivoted at P' and act on the end Q' of the crank OQ' attached to the mass system, this crank being at right angles to $P'O$ when $\phi = 0$. The moment exerted by S' will then be $M'_s = F'R'_2 \cos\phi$, where F' is the force of S' at the point ϕ, and R'_2 the radius of the crank OQ'. Now, if F' is made zero when $\phi = 0$, then $F' = R'_2 C' \sin\phi$, where C' is the rate of S', and the above equation becomes

$$M'_s = R'^2_2 C' \cos\phi \sin\phi = \tfrac{1}{2} R'^2_2 C' \sin 2\phi \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

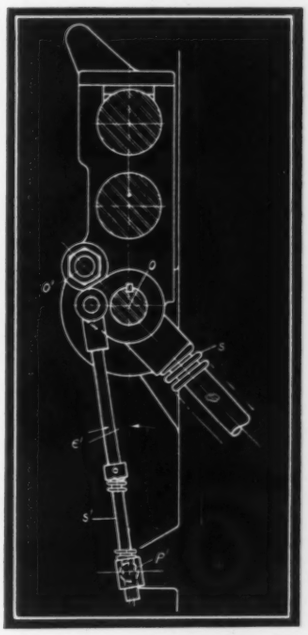


Fig. 6—Short springs under compression are used as secondary springs. Snap action can readily be attained if desired

the sum of the moments of the two springs being, adding Equations (3) and (6) together,

$$M_s + M'_s = F_o R_2 \sin\phi - \tfrac{1}{2}(R_2^2 C - R'^2_2 C')\sin 2\phi$$

If this sum is subtracted from the gravity moment given by Equation (1), it is seen

$$M_w - (M_s + M'_s) = (W R_1 - F_o R_2)\sin\phi + \tfrac{1}{2}(R_2^2 C - R'^2_2 C')\sin 2\phi$$

The condition of equilibrium at all points is that each

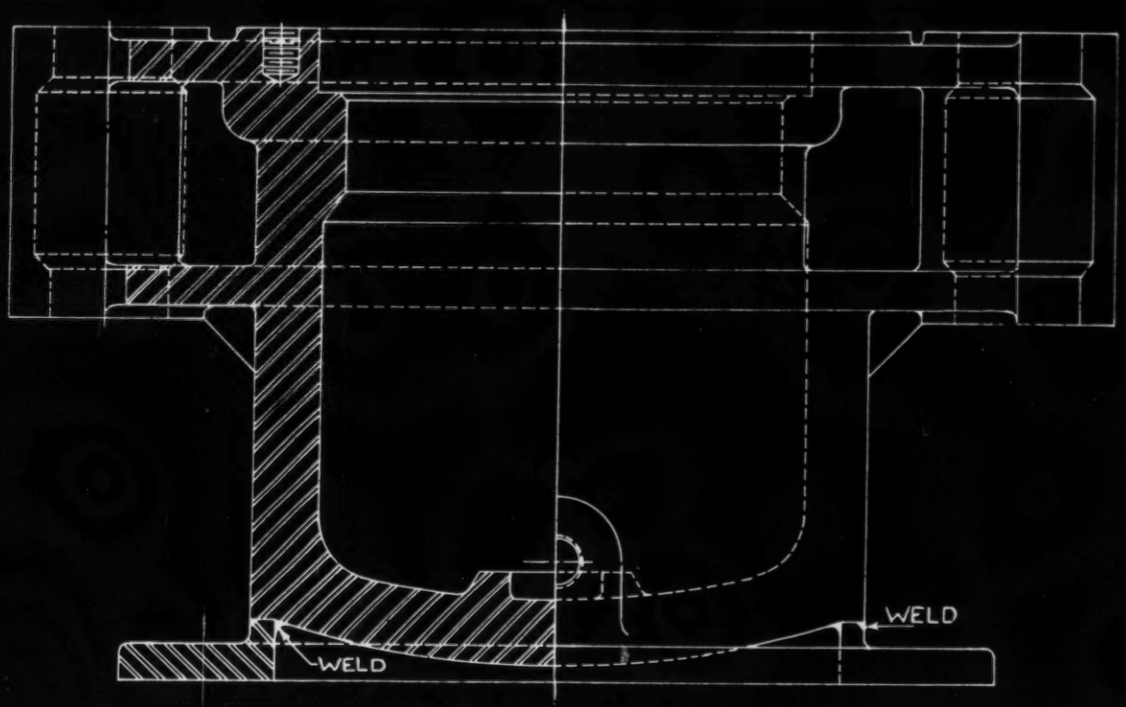
member of this equation be zero for all values of ϕ. This is only possible if each coefficient of the trigonometric functions above is zero; that is, if

$$W R_1 - F_0 R_2 = O$$
$$R_2^2 C - R'^2_2 C' = O$$

These relations being fulfilled, the characteristics of the two springs, remembering that the secondary spring S' has zero initial force, will be $F_0 = WR_1/R_2$ as before, and

$$C' = C \left(\frac{R_2}{R'_2}\right)^2 \quad \ldots\ldots\ldots\

How Welding Can Help in Redesign of Steel Castings



By Joseph A. Shuffstall
National-Erie Corp., Erie, Pa.

NO longer should designers consider steel castings as purely cast parts. In many instances welding is being combined with casting to meet specific requirements. An appreciation of foundry practice is necessary in determining whether the final design is to be a cast-welded assembly or a single cast part. Often, a slight change in web thickness or dimensions or the welding together of separate castings produces a satisfactory part which otherwise would be impracticable. Also, cost reductions are frequently effected through redesign as discussed in the following examples.

Hydraulic press cylinders of conventional design are subjected to stresses amounting to 8000 pounds per square inch with a working pressure of 2000 pounds and are tested hydraulically at 2500 pounds per square inch. A casting for this application must have excellent mechanical properties in order to withstand the service to which it is subjected. An initial failure in casting a cylinder was experienced in spite of having exercised extreme care. When placed in service in the field for a period of time, the cylinder began to

Fig. 1—Top—Cast-welded assembly of hydraulic cylinder eliminated faults in single piece castings

show signs of leakage. A destruction test revealed a faulty condition in the side wall just above the base flange. The foundry concluded, after careful study, that this condition existed because of solidification contraction at a localized hot spot at the Y junction of the side wall, base wall and ring flange.

A redesign to provide proper feeding of all parts of the cylinder is shown in *Fig.* 1. Press cylinder and base flange were cast separately and joined by welding. Not only did this improve the quality of the casting but also it enhanced the general appearance of the finished product. The new design simplified the molding problem, as the casting of the base ring integrally with the cylinder had required what is commonly known in foundry parlance as "cheek molding" or the use of cover cores—a difficult and costly process. Likewise stresses previously encountered were entirely eliminated by the new design.

Another type of hydraulic cylinder commonly known in the field is a "pull back" cylinder. Destruction tests of initial castings made from an original design revealed faults in side walls in the neighborhood of the fillet or junction of wall and seating ring. The trouble showed up on the cope side of the casting which was poured in a vertical position with open end of the cylinder up, and fed by a full ring riser. The cross section of metal at the seating ring being somewhat greater than that of the side wall proper produced a localized hot spot that could not be fed from an outside source, and hence there was no way in which to compensate for the contraction resulting from solidification. It is not surprising that the casting showed signs of seepage when placed under test. In this instance the engineers and foundrymen developed a cast steel welded design as indicated in *Fig.* 2. In the new design the seating ring has been entirely eliminated from the casting and a rolled steel ring welded in place on the outside of the cylinder wall which is now uniform in cross section. The new design has materially improved the quality of the product.

Provides for Directional Solidification

Another design problem involved an eccentric gear used in a gearing unit for the oil field industry. Such an unusual design even in the modern foundry requires special molding technique involving the use of so-called open end flasks, as the part must be cast in a perpendicular position. In order to obtain a sound structure in the hub, it was necessary to alter the original design as indicated in *Fig.* 3 to allow for the

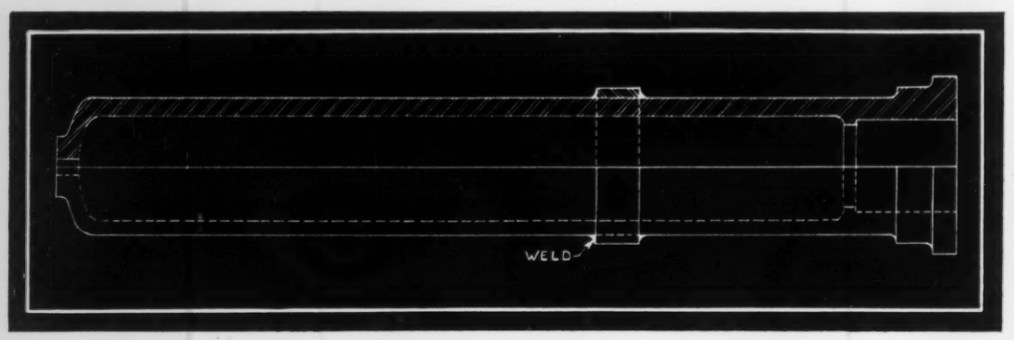


Fig. 2—Seating ring on casting replaced by welded, rolled ring

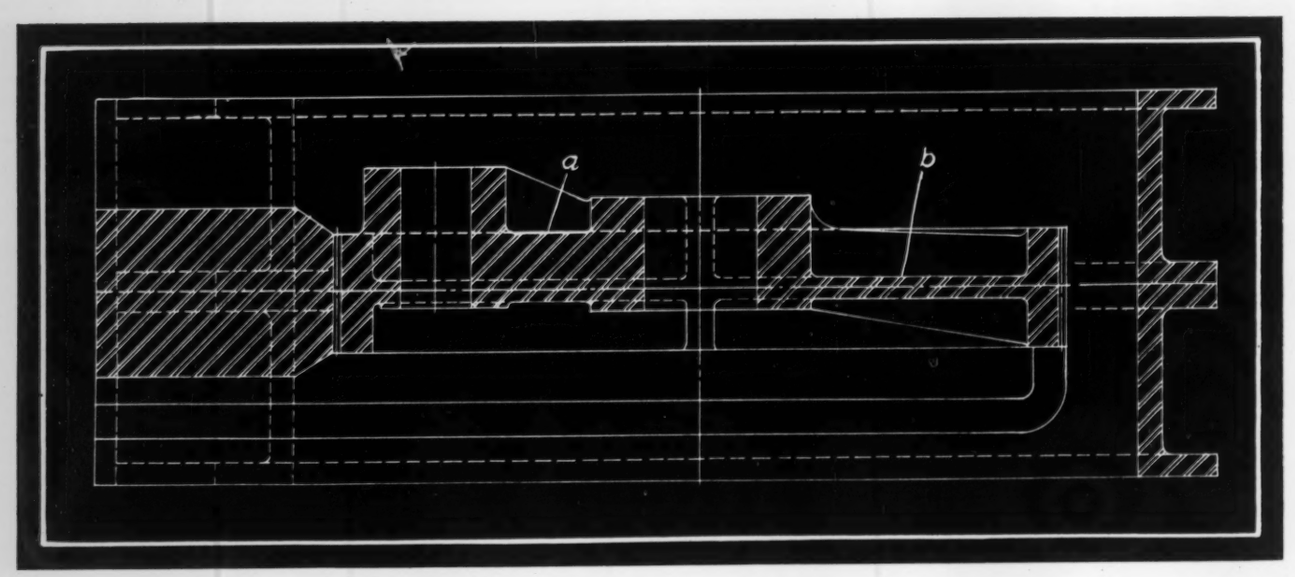


Fig. 3—Below—Redesigned eccentric gear allows for directional solidification of metal by increasing thickness of section "a", formerly the same as "b"

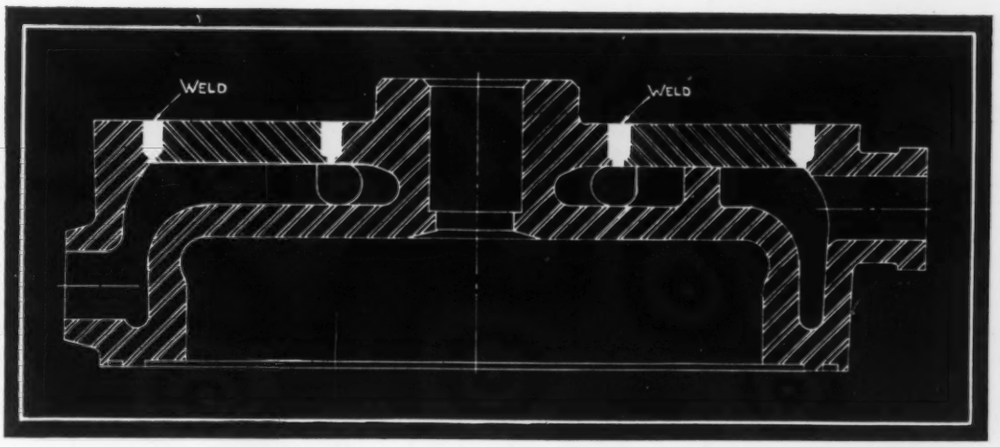


Fig. 4—Defects were eliminated by redesigning this diesel engine head casting to utilize the cast-welded assembly method

directional solidification of the metal.

During the development of the diesel engine, steel foundrymen were called upon by engineers to help pioneer the use of alloy steel castings for a number of critically stressed parts, particularly the piston heads and upper and lower cylinder heads. Temperature in the diesel combustion chamber rises to approximately 1000 degrees during each explosion and then cools down through the water circulating system. This alternate heating and cooling causes a continual expansion and contraction or "breathing" of the castings.

Composite Design for Diesel Head

Cross section of a diesel engine head of conventional type is illustrated in *Fig.* 4. When viewing this illustration it should be observed that in all cases it is vitally important that the combustion chamber be cast down or in the drag half of the mold to avoid any possibility of sand or slag inclusions or surface imperfections after machining. Around this established foundry practice redesigning was carried out and accounts for some drastic changes. In this case also a composite design comprising several castings combined by welding was decided upon. The principal reason for casting the top ring separate, as indicated by the drawing is to permit the foundry to mold in green sand instead of having to use baked cores which usually require a great many gagger rods. These cores are used to form the water circulation chambers of the casting. Shrinkage would be retarded by hard baked core sand masses. Hot tears at fillets or junctions of various sections might occur, resulting in defective castings. The new design represented in *Fig.* 4, is shown in the position in which it is cast.

Casting of some gear or pinion blanks are considered impracticable from the foundry viewpoint. One particular design created a serious foundry problem because of a narrow annular space between the outside diameter of the hub and inside diameter of the rib. This required a narrow neck of sand almost enveloped by a massive section of metal, making it difficult for the gases generated during the pouring of the steel to escape readily. Such a condition is apt to cause surface imperfections in addition to possible metal penetration of the mold or core sands, however well blended and refractory. A redesign of this gear eliminated the narrow space without in any way affecting the utility of the original design. Analysis of the cost of producing the casting by each method showed a considerable saving in the case of the redesigned job.

Careful consideration should be given each pattern job when arranging for construction, studying blueprints and designs from every angle in order to reduce pattern costs to a minimum and at the same time provide satisfactory patterns from the standpoint of the foundry. Slight changes in design in many cases lighten the burden of pattern costs and in many cases make for a better foundry job as well.

Foundries specializing in the manufacture of gear blanks, commonly construct half patterns for castings which require only half the patternmaker's labor and material. These half patterns are doweled and matched by means of master templates in order to promote maximum foundry efficiency.

For example, let us assume that the foundry's standard flask sections are 12 inches wide. In producing molds from a full, solid pattern with an 11-inch face, the drag part of the mold would require two sections of flask to provide sufficient space for the sand ramming of the pattern, whereas if a half pattern is used horizontally about the center line, the drag half of the pattern would be 5½ inches in depth thus requiring only one flask section without increasing the flask requirements for the cope.

Recognizing the importance of proper lubrication the A.G.M.A. has formed a committee to study lubricants with respect to high speeds, extreme loads, and climatic conditions. Recommended practices and specifications will be issued by the committee covering correct lubrication for gear drives under the many and varied conditions met in application.

Photoelectric Cell Adjusts Camera Exposure

Iris diaphragm is adjusted automatically for correct exposure according to selected shutter speed

UTILIZING an extremely small amount of energy, the iris diaphragm of a recently-designed camera is controlled automatically by a photo-voltaic cell. This light-sensitive device is built into the camera as shown in the accompanying illustration without materially increasing its size.

Immediately above the camera lens is mounted a multiple collective lens with the sensitive photocell behind it. The multiple lens is so calculated that it covers the exact field of the camera lens. This feature causes the photocell to react only to the light conditions in a picture scene. At the moment the shutter is released, the photocell actuates a galvanometer in the lens housing and the diaphragm adjusts to the correct aperture at the chosen shutter speed to produce a technically correct negative.

The diaphragm is so sensitive, well balanced and free from friction that the photocell is enabled to adjust the aperture according to the amount of light falling on it. Designers of the Eastman Kodak Co. have accomplished the feat of coupling a photoelectric cell with the lens diaphragm in this manner. A galvanometer dial on the lens housing permits selective readings of light and shadow areas in a scene, as with a photocell exposure meter. For special effects, the lens diaphragm may be adjusted by hand.

Always Gives Correct Exposure

If the shutter speed is changed for a later picture, the coupled photocell and diaphragm galvanometer automatically compensate with a larger or smaller lens opening. Changes of light on an intermittently cloudy day, shifts from a brilliantly-lighted scene to a shady spot, the need of a quick change from a slow to a rapid shutter speed are variations instantly equalized. Yet if the user wishes to underexpose for a certain pictorial effect, or use a large lens opening to "focus out" an obstructive background, he can push a single lever and convert the camera into a conventional focusing type.

Camera body, back and housing for range-view-finder are die-cast aluminum alloy. Borders are beaded and finished in polished chromium to contrast with the larger satin-finished metal areas and the body covering of black morroco-grain leather. Stamped extension struts support the lens and shutter assembly in the open or picture taking position.

Smoothly contoured, pleasing in appearance, the camera combines in its mechanism provisions for ease in operation. Shutter speeds are the same as usually found in a conventional camera. A newly calculated anastigmat lens is used with a speed of *f*.3.5 closing down to *f*.22.

A logical extension of the idea that a camera should be simple to operate, this automatic feature is another step in that direction. The user merely focuses and shoots.

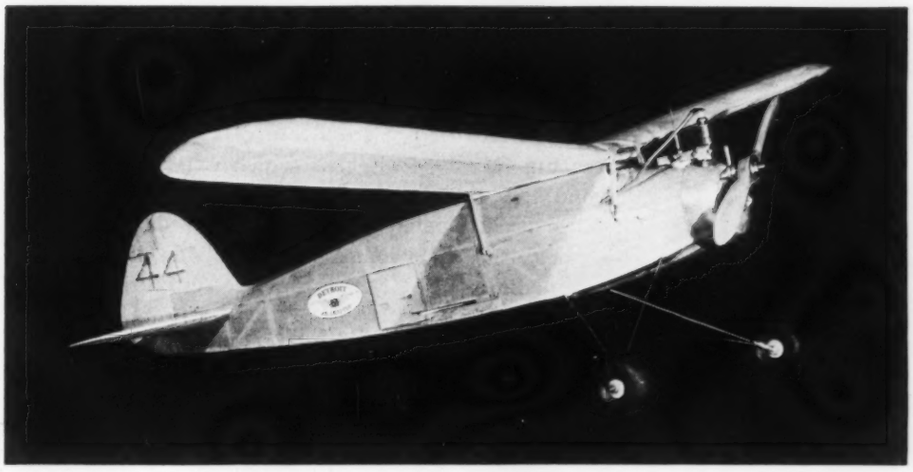


Fig. 1—Model airplane with 48-inch wing spread utilizes miniature engine capable of keeping it in air for upwards of eight minutes

Small Size, Light Weight Complicate Tiny Engine Design

By A. H. Allen

DESIGNING small-scale models of modern power units has changed from a novelty to a full-fledged industry. Demands of hobby enthusiasts and model builders have brought what were once considered children's toys to the level of accredited engineering jobs.

Aircraft is one of the latest fields to be invaded by model builders. All large cities today boast clubs and organizations which design, build and fly model airplanes. To supply their needs it has been estimated that suppliers of materials and parts did a $4,000,000 business in 1938.

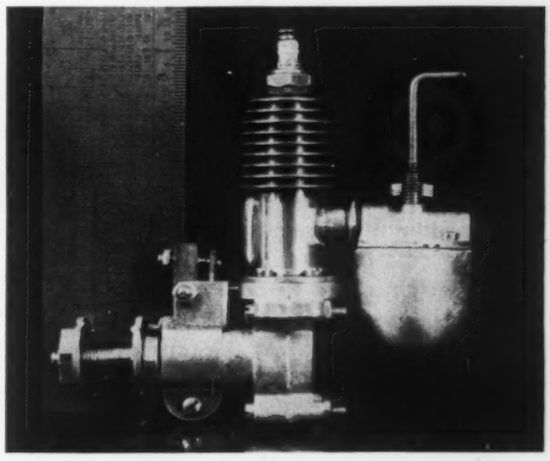
Originally model airplanes were powered by twisted rubber bands, but today gasoline power is coming into its own. At least a score of companies have developed gas engine designs for installation in model planes, ranging in size from one-eighth horsepower up to about one-half horsepower. Design problems presented by these Lilliputian power plants are unique. How they have been solved can well be demonstrated by describing one of the newest and smallest types of two-cycle gasoline engines developed for this purpose. Overall weight is 3¾ ounces; power rating is one-eighth horsepower, with speed range from 1000 to 8000 revolutions per minute. The unit is known as the Syncro Bee and is designed and built by Syncro Devices Inc., Detroit.

Essentially, the engine comprises the following parts:

(1) Cylinder assembly.
(2) Crankcase, split vertically, with main bearing in one half.
(3) Crankshaft and propeller hub.
(4) Combined carburetor and gasoline tank.
(5) Connecting rod and piston assembly.
(6) Commutator for ignition make-and-break.
(7) Cam to actuate commutator.
(8) Spark plug.
(9) Piston rings, gaskets, washers, assembly bolts, nuts, etc.

Cylinder assembly comprises four steel parts. The barrel is of S.A.E. 1112 steel, machined

Fig. 2—Side view of one-eighth horsepower engine, with die cast aluminum gas tank at right



bar, with six cooling fins at the top and a flange at the base for bolting to the crankcase. Fin and flange diameter is ⅞-inch, outside diameter of the barrel 9/16-inch, bore ½-inch, overall length without head 1½ inches. To permit broaching the bore, the cylinder head, drilled and tapped for the ¼-inch diameter spark plug, is made separate on a screw machine and is threaded into the finished cylinder barrel after broaching. After the cylinder is machined it is drilled with four 7/64-inch holes in the flange, and four pairs of 5/64-inch holes in the lower part of the barrel for intake, exhaust and bypass ports. Two pairs of bypass ports are on one side of the barrel, diametrically opposite the intake and exhaust ports.

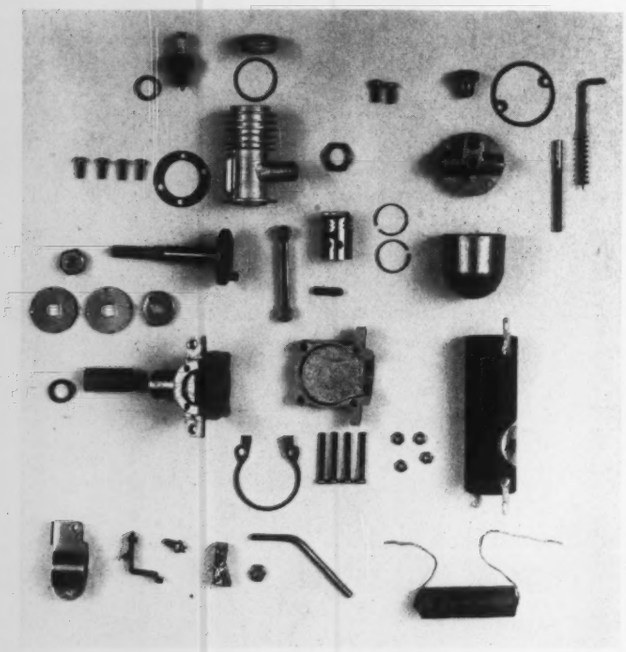


Fig. 3—An idea of the job involved in the small power plant may be gained from these disassembled parts

The bypass ports are covered with a .020-inch stamped steel cover plate, ¾ x ½-inch, curved to the contour of the barrel. Over the intake ports and just below the exhaust ports is placed an intake fitting, 5/16-inch in diameter, threaded to receive the carburetor and gas tank assembly.

Tack welds first spot the bypass cover plate and intake fitting. A fine copper wire is laid around the periphery of the cover plate before welding and a small slug of copper is dropped into the intake fitting. This assembly then is passed through a copper brazing furnace where the copper melts and flows around the joints, making them secure. A final cadmium plate is given the exterior of the cylinder assembly for corrosion resistance.

Comprising a front and back half, the crankcase is of die cast aluminum. At the top are flanges for receiving the cylinder barrel and for mounting the engine in position. Inside, the crankcase is circular, slightly larger than the disk attached to the end of the crankshaft carrying the pin on which the connecting rod rides. Diameter of the crankshaft chamber is 15/16-inch, width ¼-inch. A gasket fits between the two halves to make the assembly airtight.

Front half of the crankcase carries the crankshaft bearing in a ½-inch boss which extends 1 inch beyond the outside of the casting. The bearing, an Oilite prelubricated type of compressed and sintered copper, is ¾-inch long, ⅜-inch outside diameter, accommodating the ¼-inch diameter crankshaft.

Crankshaft Receives Propeller Assembly

The crankshaft is of S.A.E. 1020 steel, 1⅞ inches in length, with a 3/16-inch thread extending back on one end to receive the propeller assembly. Immediately back of this threaded portion is a squared section, 3/16 x 3/16, to receive a stamped steel cam which actuates the commutator. Terminating the other end of the crankshaft is a machined steel disk with a steel pin set in a hole 1/16-inch from its outer edge. The pin is copper brazed into the disk and the latter is copper brazed onto the shaft in much the same way that the cylinder assembly is handled. After brazing, the crankshaft is hardened by immersion in a bath of liquid cyanide at 1450 degrees Fahr. and quenched in oil. Surface is file hard to a depth of about .006-inch. To remove .002-inch of stock before assembly, the bearing surface then is centerless ground.

A cup-shaped unit 1 inch in diameter and about 1½ inches deep, the carburetor and gas tank comprises a die cast aluminum bowl onto which is bolted a die cast aluminum top carrying a brass tube extending to the bottom of the bowl. The upper portion of this tube cuts across the intake passage which is tapped to be attached to the cylinder intake fitting. A small hole is drilled through the brass tube at this point and a needle valve arrangement is obtained by

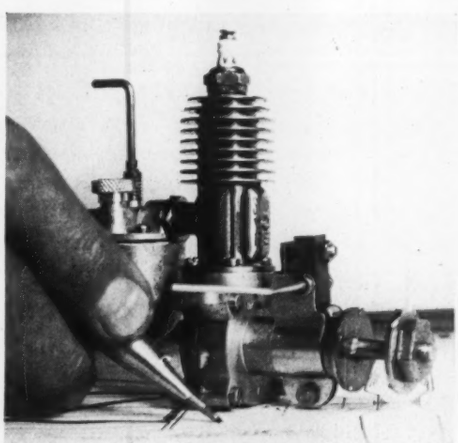


Fig. 4—Front view of miniature engine, propeller assembly being mounted on pin at right

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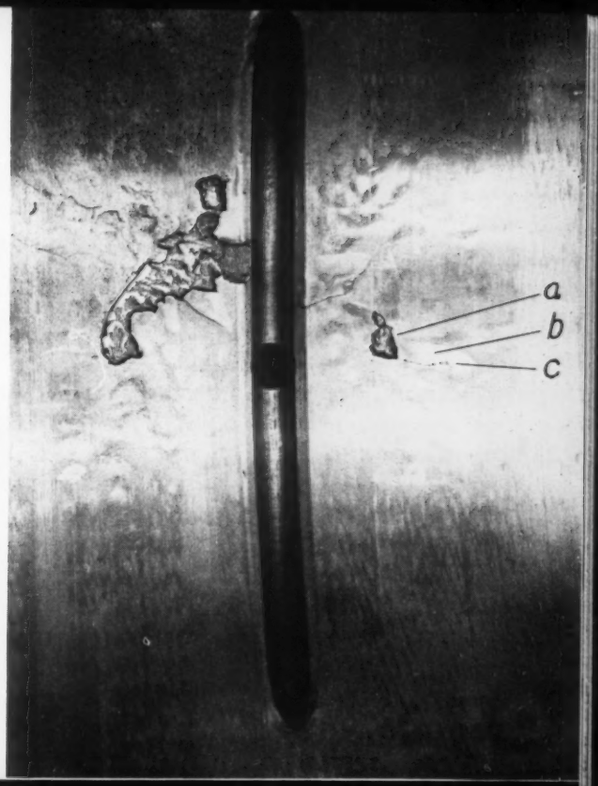
Why Thermal Stresses Cause Failure of Parts



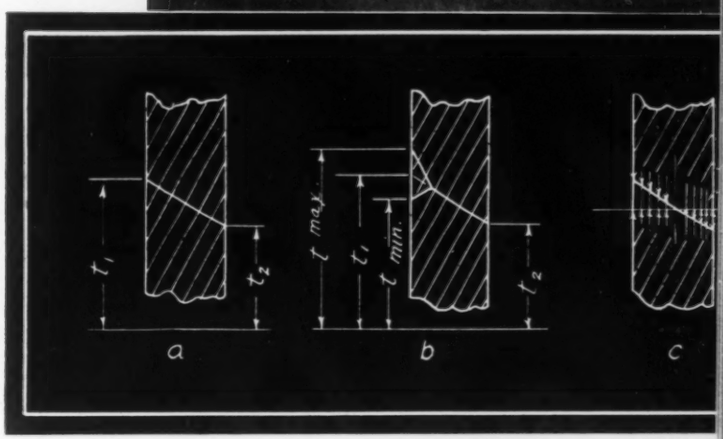


Fig. 1—Top—Crankpin bearing for diesel showing failure due to excessive heat. Fig. 2—Above—Temperature drop through homogeneous walls

By H. F. Shepherd

ANALYSIS of thermal stresses is equally as important as the calculation of stresses caused by vibration. Vibration studies, on the one hand, have revealed stresses unsuspected by the static theory of design in which a machine is proportioned on the assumption that it resists, without motion, a static force equal to the maximum applied force. Heated machine elements, on the other hand, although subjected to the simplest stresses in the elementary analysis in which the "cold" machine is considered as a parallel to the static machine, resist additional and sometimes destructive stresses set up by temperature gradients.

The theory of heat transfer through homogeneous walls is well established. The temperature gradient or graph *Fig.* 2*a* of temperature drop through the wall is a straight line joining t_1 the temperature on the hot side and t_2 the temperature on the "cold" side. Heat transfer is measured by the cumbrous unit k=B.t.u.'s per square foot of surface per degree difference of temperature per inch of thickness per hour. Translated, this means that the heat flow through a wall is

(1) Directly proportional to the rate of heat input k
(2) Inversely proportional to the wall thickness s
(3) Directly proportional to the temperature drop $t_1—t_2$

The actual heat flow in B.t.u. square foot-hours equals

$$Q=k(t_1—t_2)/s.$$

How the wall is stressed or deflected in seeking relief from stress under the influence of a temperature gradient depends upon the forces tending to restrain it. The receiving side tends to elongate more than the cooler side which dissipates the heat. If the wall is an unrestrained plate it simply bows, remaining free of thermal stress. However, if the wall inherently retains its original form, as do cylindrical envelopes heated on one side, the thermal stress is superimposed upon other stresses due to pressure, centrifugal force, etc.

Thermal stresses in walls geometrically rigid are deduced as follows: Again referring to *Fig.* 2*a*, $(t_1+t_2)/2$ equals the mean temperature. The plate expands linearly or the cylinder circumferentially to unit dimensions determined by the mean coefficient of expansion of the material used and the mean temperature. The hot side, expanding more than the mean, is subjected to compression whereas the cold side, expanding less, is subjected to an equal and opposite extension, as in *Fig.* 2*c*. At mid-thickness a

neutral axis is subjected to no thermal stress within the elastic limit of the material.

Stresses due to the prevention of thermal expansion are exactly equivalent to those produced by the same degree of elastic strain. For example, if the coefficient of expansion e is .000006 and the modulus of elasticity E is 30,000,000, the outermost fiber stress set up in a geometrically restrained plate by a uniform temperature rise of one degree, pounds per square inch, is

$$S = e\,E/2 = .000006 \times 30{,}000{,}000/2 = 90$$

From this it is apparent that a temperature gradient of as little as 300 degrees may produce a

Fig. 3—Brake drum failure through excessive friction. Hair line fissures appear in bright areas

dangerous stress in mild steel which has approximately the foregoing characteristics. Fortunately, fired pressure vessels are in a great measure saved from destruction by a layer of inert gas insulating their heat-absorbing surfaces.

Brief discussions of the nature of thermal stress failures may point the way toward designing for maximum service where they have not already been charted. *Fig.* 4 shows at *a* an element of a cylinder in thermal equilibrium, *b* a surface upset due to heating the exterior surface sufficiently above the temperature of the inner surface to set up thermal compression exceeding the elastic limit. At *c* is shown a fissure resulting from the metal cooling to its original temperature. Due to this upset condition, the outer skin was unable to resume its former dimensions without exceeding the elastic limit of the cylinder material.

In *Fig.* 3 a section of a brake drum is illustrated. The bright areas are the upset portions which naturally were polished by the brake shoes. Hair lines bisecting each polished area are the incipient failures due to tension in the outer skin as the drum cooled, shrinking upon the less heated and less strained inner material.

A reversed case is that of the diesel crankpin bearing, *Fig.* 1, which failed due to excessive friction heat. Similar polished areas, *b*, bisected by like fissures *C*, are visible. Bearing failures, it may be noted, have much the same appearance as those due to impact except burnished ridges are absent in the latter. Impact failures in bearings always begin at the points of maximum oil film pressure while thermal stress failures may originate at any area where lubrication is sparse, resulting in boundary instead of film lubrication.

Still further confirming this theory of the mechanism of failure are the researches of J. R. Adams and H. L. Watson Jr. on the grinding of steel mill rolls.* *Fig.* 5, from these researches, shows a roll that cracked and spalled in machining due to harsh accidental contact with a grinding wheel. The wheel was fed in while the job was stationary. Failures of this sort are common where dry grinding is practiced or where glazed wheels are used by careless machine operators.

Stress Occurs on Compression Side

It is curious, but not unnatural, that thermal stress failures almost invariably occur on the side in compression, even in the case of cast iron which at low temperature has a compressive strength much exceeding its tensile strength. Several adequate causes for this exist, perhaps all co-acting.

In such failures the heat flux usually is intermittent or periodic. Consequently the temperature gradient is not always a straight line because the metal must serve as a thermal reservoir absorbing and giving off heat as in *Fig.* 2*b*. This results in additional skin stress on the hot side.

Also, the strength of some materials such as babbitt metal and brass falls rapidly with the temperature, consequently the hot side is weaker. In addition, the cool side may elongate in service if the metal is ductile so that it is in compression when the wall is in thermal equilibrium thus increasing the tension of the outer skin when it cools and its compression when hot.

There are two primary problems in the design of walls for the best resistance to thermal stress. The first is the choice of materials as judged by their simple physical properties. Ideal material for a

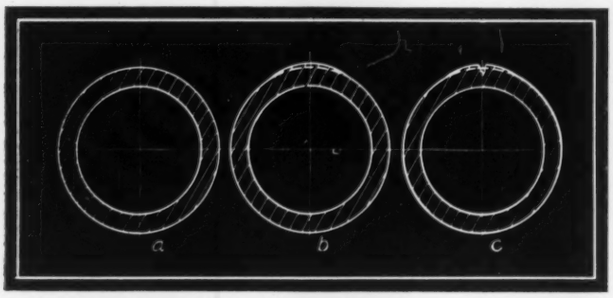


Fig. 4—Cylinders under various temperature conditions

* *Steel*, Nov. 21, 1938

thermally stressed wall would be one having the following characteristics:

(1) High thermal conductivity k
(2) Low coefficient of expansion e
(3) Low modulus of elasticity E
(4) High elastic limit S_e independent of or well sustained with temperature
(5) High specific heat c or thermal capacity for absorbing cyclical fluctuations of heat input without undue local rise of temperature.

The second problem is the origin of the heat which produces thermal stress, as,

(1) Walls heated by mechanical friction
(2) Walls heated or cooled by a fluid medium under negligible pressure
(3) Walls heated or cooled by a fluid medium under appreciable pressure.

Many metals of high conductivity are eliminated in application by their unkind behavior toward the contacting material. Those available for journal bearing linings subjected to heat of friction are not as widely varied as their nomenclature might suggest. A few bronzes and white metal alloys cover the range. Many of them survive only under strictly limited temperature conditions but there is unfailing evidence that superior compressive strength under high temperatures is an essential characteristic of the most resistant metals.

Application Determines Materials

Friction is inherent in clutches and brakes, necessarily mitigated by the use of non-scoring materials. One or both of the materials is usually somewhat friable, comprising a brittle matrix with graphitic or organic inclusions. Cast iron is naturally graphitic. Most composite friction linings include a lubricating binder to enable them to work against steel or iron.

Cast iron with its low modulus of elasticity and coefficient of expansion, its slightly higher conductivity and specific heat, and its well-sustained tensile strength (or modulus of rupture) still competes strongly with steel in friction apparatus. This is especially true when wall thickness is determined by wear allowance rather than by stress-carrying capacity. In such cases the steel wall may be made as thick as the cast iron wall to the disadvantage of the former. Cast iron is not always satisfactory because its failures are disruptive. This fault is mitigated in the design of railway and other brake shoes by casting in a mesh of expanded metal (steel). This does not actually reinforce the shoe but serves to prevent it from disintegrating when thermal stresses cause crazing of the working surface.

The road is widen open in the choice of materials for heat exchangers and condensers. There the stresses are almost entirely thermal so that materials may be chosen for high conductivity and corrosion resistance. In the case of copper, brass, etc. these qualities are not entirely incompatible. High coefficients of expansion may be offset by use of bent tubes or by expansion joints on tube ends or tube headers.

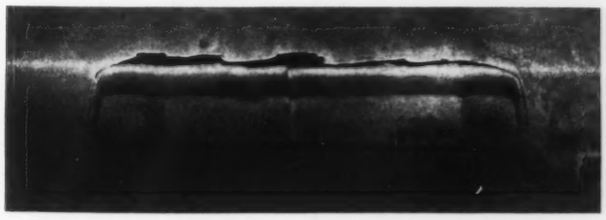


Fig. 5—Failure caused by grinding wheel burn

Casings of superheated steam apparatus and the cylinders and cylinder heads of internal combustion engines differ from the foregoing in that the walls are under appreciable pressure. Maximum temperatures in steam apparatus are fixed by the laws of vapor pressure and by controlled superheat. Conduction of heat is avoided as far as possible by steam jacketing and by lagging. Stresses due to gradients may be avoided by careful warming of apparatus before it goes into service. Those due to linear expansion are provided for by liberal allowances in design.

Gradients are unavoidable in the cylinders and heads of combustion engines because flame temperatures and even mean temperature are far above the endurance of the walls. In such cases air or water cooling must be applied. Turbulence disturbs the insulating film of inert gas which protects the walls in the case of boilers, etc. Cast iron, steel and aluminum vie with each other for position in these applications, the choice being governed largely by mechanical design considerations.

Thin Walls Reduce Stresses

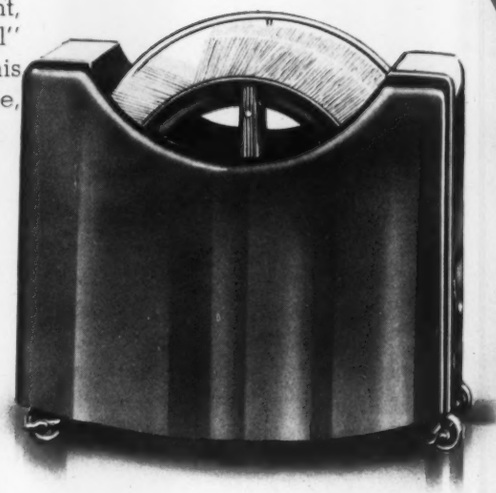
Simple rules govern the design of walls subjected to stress due to temperature gradients. Material having been chosen for mechanical fitness, the walls should be made as thin as possible. Ribs never should be used for strength. If required for heat dissipation they should be designed as sections just heavy enough to stand machining but not sufficiently stout to contribute to the tensile strength of walls or to project the neutral axis of thermal stress outside of the wall proper. The design of aircooled airplane motor cylinders is an adequate guide in this field.

There remains an immense field for research in this branch of design. Tables of physical properties of available materials are incomplete as to physical constants at temperatures below 750 degrees Fahr. Growth and creep are not serious considerations at the temperatures generally encountered in machine elements but adequate and convenient tables covering specific heat, coefficient of expansion, elastic limit and thermal conductivity for proprietary and common materials would be of great value. However, this lack of data should encourage individual research.

The RCA one-kilowatt television transmitter, above, employs a long line controlled oscillator using an invar rod which is unaffected by changes in temperature to maintain the carrier frequency at a stable value. Because of the relatively high power output from the oscillator, only two buffer amplifier stages are necessary to drive the final power amplifier stage. A special modulator circuit is used for carrier control during transmission

A new six-tooth spline drive [illegible] Boice-Crane drill press [illegible] contact surface of the [illegible] teeth sides increases [illegible] qualities at high speeds. [illegible] is built into the machine [illegible] its modern appearance. Two [illegible] grease-sealed ball bearings [illegible] mounting the steel drive [illegible]

The Diebold Cardineer, right, embodies a molded Durez plastic wheel on which thousands of filing cards are easily available. Light weight, durability and "eye appeal" were factors in choice of this material. The lockable, hooded cabinet is steel



Design F[illegible]
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A Pictorial Presentation [illegible] chinery from the [illegible]

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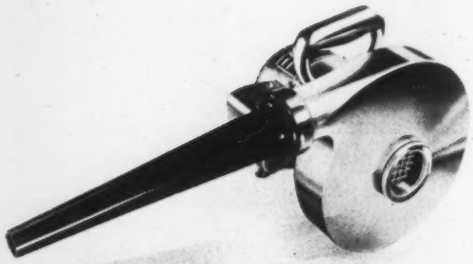
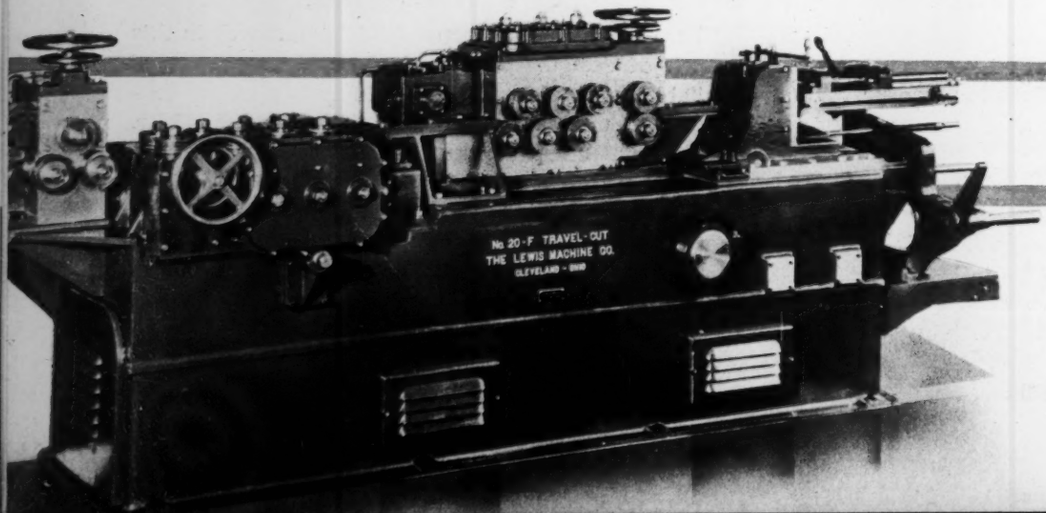
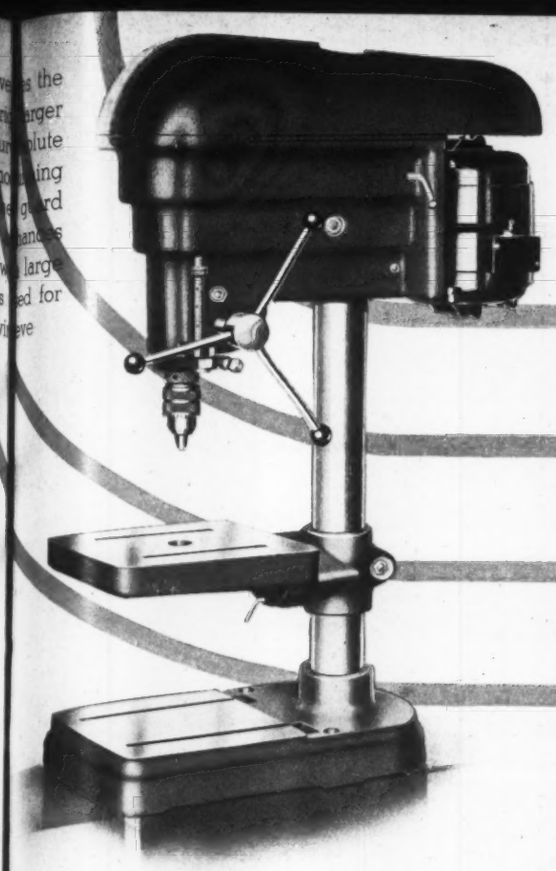


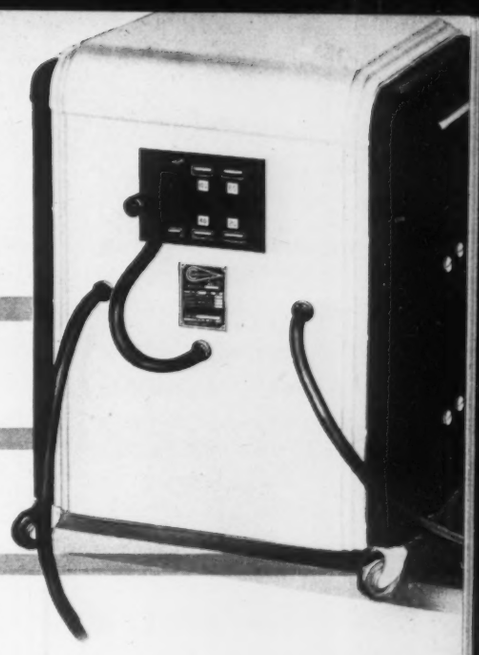
Housing of the Clements Cadillac all-purpose blower, right, is sand-cast aluminum, with cast aluminum fan statically and dynamically balanced. Low torque on starting is obtainable with low-speed switch and safety in suction cleaning is guaranteed by operating on this stage. Sealed type ball bearings, requiring no oiling, and universal type motor are used



The Lewis rod straightening and cutting machine, left, is equipped with a flying shear type cutoff, length of rod being simply adjusted by a gage. It has forced feed lubrication to cutoff headways and a centrally located oil tank and pump. Bearings are antifriction throughout and multiple V-belt drive comes direct from motor mounted in closed steel base



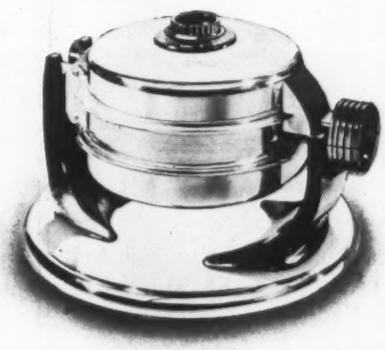
All wires, transformer and reactance coils in the Commonwealth arc welder, right, are insulated with flexible, Vitrotex glass capable of withstanding temperatures up to 900 degrees Fahr., and resistant to water, oil and acids. The welder's handsome cabinet is made of 16-gage steel. Control panel provides range from 20 to 120 amperes



gn Features ew Machines

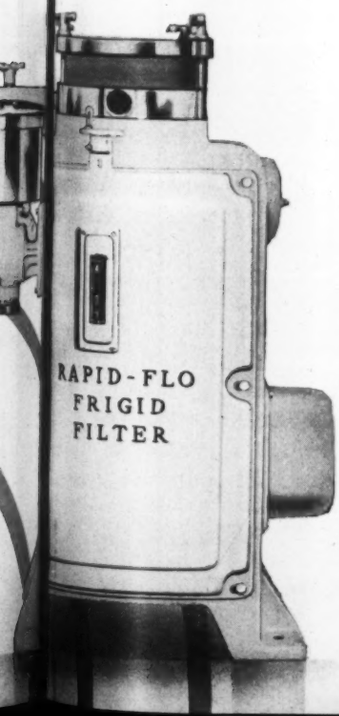
l Presentation of Recent Ma- om the Standpoint of Design

r new machines see page 96)

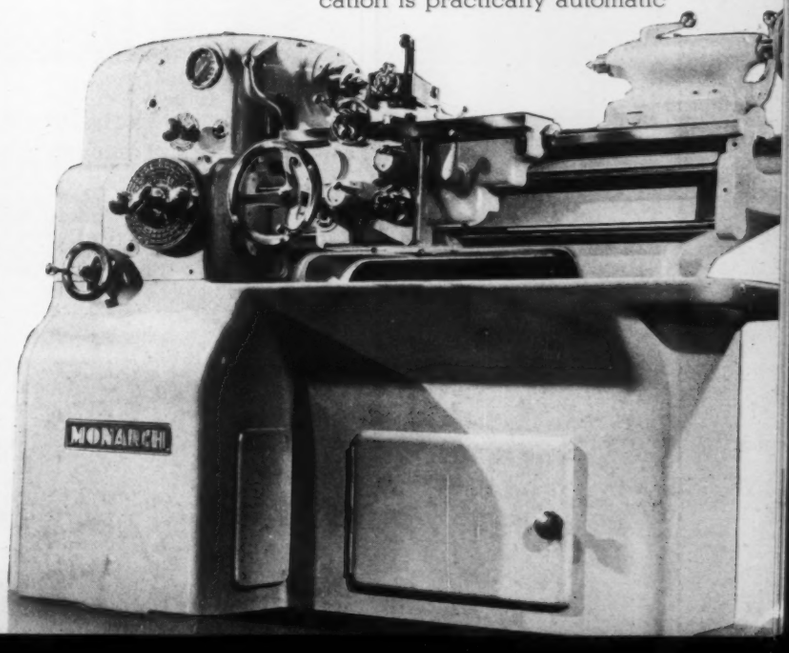


Supports, handles and knobs of the Manning, Bowman automatic Twinover waffle iron, left, are made of Bakelite because of its appearance, heat resisting qualities, low cost. On the top is a dial which sets a thermostat to regulate the baking time for waffles, shutting off the current when the process is completed. The iron, which bakes two waffles at once is chromium plated. Baking grids are equipped with nichrome elements

Carriage of the Monarch precision lathe, below, is maintained in alignment with the flame-hardened and ground bed ways by adjustably-mounted ball bearings located beneath the ways. All castings except the one-piece base casting are made of Meehanite in various grades. Operating steel parts are of nickel alloy steel, electric furnace hardened. Protruding and unsightly levers have been eliminated, in keeping with "cleanlined" design, the machine having been developed from a full-size wood and composition model. Lubrication is practically automatic



To drive milk at a uniformly constant rate of speed, a rotary positive displacement pump is used in the Johnson & Johnson Rapid - Flo frigid filter, left. Variable speed transmission controls the rate of milk supply to the cooler or the pasteurizer. Filter head at top, strainer and pump are made of nickel alloy. Interior housing is coated with rust - resistant paint, exterior finished in white enamel. Filter cartridge is laminated cotton



If Money Must Continuously Be Spent— Spend Some on Research!

BILLIONS are being spent annually. Not this year or last year but concurrently for the past six! Are we any further along in civilized progress—or any nearer to that basically sound recovery supposedly "just around the corner?"

Granting that there have been certain legislative steps taken during this period that can be said to benefit the community at large, the answer to the foregoing still remains essentially "No." It is all too apparent that the time has come to consider entirely new avenues of approach—not necessarily reversing every plan now in operation, but supplementing current measures from totally different angles.

Past recoveries from depressions can be traced to the creation of new industries. We may hope that history will automatically repeat itself. How much greater would be that hope, however, and how much more logical would be the reason for it, if the government would turn to the direct assistance of business enterprise rather than the indirect assistance it believes it is giving through present-day relief methods?

Innumerable channels exist through which industry could be helped. Think of the possibilities if even a fraction of the huge sums now being disbursed could be diverted to research—by industry and through industry. The research could be both technical and commercial. New machines, new devices, new equipment to obsolete old, new defensive war-time equipment, new methods, new markets—the road is open to all!

Opponents of "government-in-business" procedure would be aghast in the event such a plan took root. But they could have little objection if equitable methods were followed. Monetary grants might be arranged to clear, for instance, through impartial trade associations and engineering societies or similar organized bodies. And a far better check on results would certainly be available under such a system than under the current haphazard spending program.

Spending for the sake of spending is disastrous. But if, as many feel, money *must* be spent, it should at least be distributed in the quarters that will yield the most commensurate and adequate return.

Men of Machines

ROBERT J. MINSHALL

WITH designing as his hobby as well as his profession Robert J Minshall, formerly engineering vice president and now appointed vice president and assistant general manager of Boeing Aircraft Co., is rated one of the industry's ablest design engineers. Reared in a railroad atmosphere, he departed from the "ways of all Minshalls" at the early age of eleven and began building model planes.

Starting at the bottom in the aircraft shop of Eugene Ely, aviation pioneer, Mr. Minshall widened his practical experience later through association with the Oregon Aircraft Co. Turning then to designing he developed his first plane, a seaplane with two Ford automobile motors.

Mr. Minshall joined the Boeing company in 1918 in the assembly shop, and in a year was in the engineering department. In 1928 he became design engineer and in 1936, chief engineer.

•

EDMUND A. PRENTIS

TO CARRY on the activities of the American Standards association as "national clearing-house for the standardization work of American industry," Edmund A. Prentis was elected president, succeeding Dana T. Barnum, at the recent annual meeting of the twenty-year-old association. Mr. Prentis is secretary and chief engineer of Spencer White & Prentis. Active in the work of the association, he has been a member of the board of directors since 1935, and for three years served as its vice president.

Born in New York city in 1883, Mr. Prentis graduated from Columbia university in 1906. He is a trustee of the university at the present time. In addition to being an author of several articles and books, he is co-inventor of the Pretest underspinning system.

•

E. W. SEEGER

ASSOCIATED with Cutler-Hammer Inc., for fifteen years—that is since graduating from Ohio State university in 1913 with mechanical and electrical engineering degrees—E. W. Seeger, formerly assistant chief engineer of the company, has had wide experience in shop and engineering departments and thus is well fitted for his new position as chief engineer.

Mr. Seeger's connection with the company began as an apprentice in the shop and test room. Upon completion of this course he was transferred to the engineering department where he served as an application engineer in the manual starter, elevator and mill departments. In 1917 he was placed in charge of the automatic starter section, subsequently becoming general engineering supervisor. His activity during this period was in connection with the design of controllers for printing presses, automatic

substations, synchronous motors and isolated engine-driven electric plants. His appointment as assistant chief engineer, in charge of the application engineering department, came in 1928.

He is author of several articles on the control of electric motors, and has taken out approximately sixty patents in the electric control and related fields.

♦

JOHN W. VOTYPKA has been named chief engineeer of the Fruehauf Trailer Co. Mr. Votypka, who was formerly chief engineer for the Le Baron division of Briggs Mfg. Co., Detroit for 12 years, is assistant vice chairman in charge of automobile body activity for the Detroit section of the Society of Automotive Engineers.

♦

DONALD B. GILLIES, vice president of Republic Steel Corp., Cleveland, has been elected president of the American Institute of Mining and Metallurgical Engineers.

♦

DUGALD C. JACKSON has been awarded the 1938 Edison medal of the American Institute of Electrical Engineers, highest award in the profession, "for outstanding and inspiring leadership in engineering education and in the fields of generation and distribution of electric power." Dr. Jackson is professor emeritus of electrical engineering of Massachusetts Institute of Technology.

♦

G. B. SCHUYLER has been appointed executive vice president, a newly created post, of the Apex Electrical Mfg. Co., Cleveland.

♦

LOUIS W. FALK has been made executive engineer of The Falk Corp., Milwaukee, and W. P. SCHMITTER becomes chief engineer. HAROLD S. FALK, vice president of the company, continues in his present capacity as director of engineering.

♦

GEORGE SACHS has joined the faculty of Case School of Applied Science, Cleveland. He was previously head of the mechanical and X-ray departments at the Kaiser Wilhelm Institute, Berlin.

♦

DAVID E. ANDERSON has resigned as chief engineer of Bohn Aluminum & Brass Corp. to become research engineer of Holley Carburetor Co. Mr. Anderson is a widely-known automotive engineer in connection with his research work on internal combustion engines and fuels.

♦

DANIEL S. EPPELSHEIMER, formerly with Union Carbide & Carbon Research Laboratory, Niagara Falls, N. Y., has been appointed research associate professor of industrial engineering at the University of New Hampshire. Dr. Eppelsheimer will head the industrial research of the engineering experiment station, College of Technology.

♦

JOHN KYLSTRA has been named chief engineer of Boeing Aircraft Co., and JAY MORRISON as assistant to the president of the company.

♦

JOSEPH H. HEIL, associated with Heil Co., Milwaukee, since 1923, and vice president since 1931, has been elected executive vice president.

♦

WEBSTER N. JONES has been elected president of the American Institute of Electrical Engineers. He is director of the college of engineering at Carnegie Institute of Technology.

♦

P. B. HARWOOD, formerly general engineering supervisor of Cutler-Hammer Inc., Milwaukee, has been made assistant chief engineer. Mr. Harwood has been in the employ of the company since 1917, after graduating from Carnegie Institute of Technology. He entered the company's training course and was later transferred to the engineering department as design engineer. In 1928 he became general supervisor of the engineering department.

♦

G. H. HEDRICK, for the past ten years chief engineer for the Gem Mfg. Co., has been appointed chief engineer of the muffler division of Maremont Automotive Products Inc., Chicago.

♦

CHARLES H. HUGHES, for many years research engineer and designer of equipment for Semet-Solvay Engineering Corp., has been employed as a consulting refractory engineer by North American Refractories Co., Cleveland.

♦

CLINTON S. MESSLER, vice president and chief engineer of Green Fuel Economizer Co. Inc., Beacon, N. Y., has taken charge of production of the company. He has been chief engineer since 1917, and is a graduate of Worcester Polytechnic institute.

♦

JAMES H. GAMBERTON has recently been added to the technical staff of Acheson Industries Inc., New York, as mechanical engineer to supervise engineering tests involving new applications of the products of the company's affiliate.

♦

WILFRED E. JOHNSON has been presented with the newly-established gold medal award for outstanding achievement by Pi Tau Sigma honorary engineering fraternity at "Honors Night" of the American Society of Mechanical Engineers. Mr. Johnson, 33-year old design engineer, has been associated with General Electric Co. for the past eight years.

ASSETS *to a* BOOKCASE

Mechanics of Machinery

By C. W. Ham and E. J. Crane; published by McGraw-Hill Book Co. Inc., New York; available through MACHINE DESIGN *for* $4.00, *postpaid.*

Primarily a college textbook, this 476-page work in its second edition contains many changes in arrangement and content, with new material added and a large number of problems included. Purpose of the book is not to present a complete treatise but is limited to material necessary to bring out fundamental principles and methods. A new feature of this edition is the large number of up-to-date problems for drafting-room work, with dimensions, scale and location on sheet given. These problems, it is stated, have been selected with a view to illustrating, as far as possible, practical applications of fundamental theory.

Material covered includes sections on linkwork, cams, gearing, belts, intermittent-motion mechanics, trains of mechanisms with a detailed study of kinematics and dynamics of machinery.

□ □ □

The Internal Combustion Engine

By D. R. Pye; published by the Oxford University Press; available through MACHINE DESIGN *for* $5.00 *postpaid.*

Although in two volumes, Volume 1 only has been revised. In this new edition, principles of design and operation of internal combustion engines are discussed skillfully and concisely. Material on diesel engines, detonation and combustion calculations have been added in the light of present-day research. The products of combustion, cycle temperatures, properties of various fuels, thermal efficiencies are included as they affect the operation of gasoline, gas and diesel engines. The second volume, not revised, treats the design of airplane engines.

□ □ □

Mechanisms

By Robert McArdle Keown and Virgil Moring Faires; published by McGraw-Hill Book Co. Inc.; available through MACHINE DESIGN *for* $2.75 *postpaid.*

Completely rewritten, this fourth edition of *Mechanisms* was revised to keep the book abreast of modern developments and to improve its presentation. Designed for textbook use it defines the many methods for translating motion. Simple diagrams clearly illustrate the text and photographs show application to industrial equipment. Sufficient problems with each chapter familiarize the student with the utilization of mechanisms.

Included in addition to chapters on the theory of mechanisms and motion are discussions of flexible connectors, cams, gearing and miscellaneous devices. Methods employed for cutting gear teeth are described. Drawing gear teeth, graphical solutions, and general problems in acceleration also are discussed.

□ □ □

Formulas for Stress and Strain

By Raymond J. Roark; published by McGraw-Hill Book Co. Inc.; available through MACHINE DESIGN *for* $3.00 *postpaid.*

Formulas, tables, definitions and reference data on stress analysis are included in this handbook in readily usable form. In the chapters dealing with structural members, typical cases are discussed followed by variations in form and loading. Beams, plates, columns, pressure vessels, bodies under direct loading and shear, are types of structural elements for which stress tables are included. Elastic stability and dynamic and temperature stresses are also fully covered.

□ □ □

Structural Aluminum

Compiled and published by the Aluminum Co. of America; available through MACHINE DESIGN *for* $1.25 *postpaid.*

This second edition of a handbook for designers on the selection and use of aluminum parts and structural shapes includes considerable new and useful information. The new material involves discussions and tables of the ultimate strength of structural members fabricated from aluminum alloys, based on laboratory investigation, field tests and practical usage.

Refinements in manufacture and fabrication as well as increasing application are reflected in the data contained in this edition. Those sections on production and characteristics have been enlarged. Commercial sizes, tolerances and specifications have been added. Expanded tables of structural shapes, torsional con-

stants, and elements of sections for rectangular shapes and tubes are included and arranged to facilitate computations.

Properties of aluminum and methods of fabrication are discussed including forming, machining, riveting, welding and casting. Allowable working stresses are worked out for various sections and kinds of stress. The chapter on design considerations deals with such important factors as deflection, rivet spacing, concentrated loads and vibration.

□ □ □

Manual of Mathematics and Mechanics

By Guy Roger Clements and Levi Thomas Wilson; published by McGraw-Hill Book Company Inc.; available through MACHINE DESIGN *for* $2.50 *postpaid.*

Flexibly bound, this manual is useful to engineers requiring a ready reference volume of facts, formulas and tables. The numerical tables included are sufficient for four-figure accuracy. Such topics as the solution of plane and spherical triangles, infinite series, integration, tables of integrals, solution of ordinary differential equations of mechanics and physics have been outlined more completely than usually is done. Ample provision is made for the simplifications that can be made in many theoretical discussions and computations by the use of hyperbolic functions. The manual is particularly planned for rapid use with minimum eye strain.

□ □ □

Air Conditioning, Heating and Ventilating

By J. Ralph Dalzell and Charles L. Hubbard; published by American Technical Society, Chicago; available through MACHINE DESIGN *for* $4.00 *postpaid.*

A practical treatise on the principles and application of steam, hot water, vapor, vacuum and forced air for heating together with split systems for heating and ventilating and air conditioning, this book covers methods for calculating such systems.

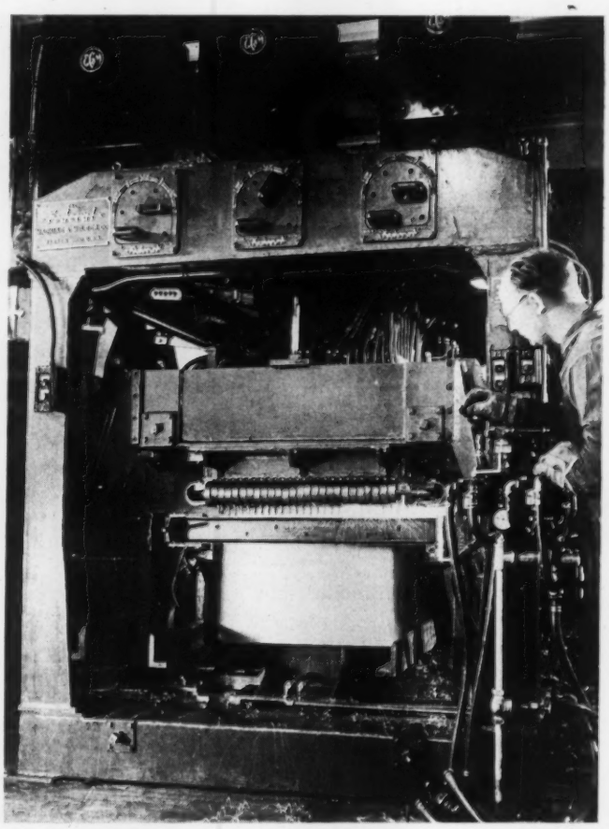
The authors discuss methods for designing systems in easily applied terms. Because practices have not yet been standardized they give several different methods of calculation. Many representative jobs are included to show the application of the principles involved. Standards are interpreted with respect to dust, air motion, temperatures and humidity with their relation to system design.

Descriptions of each type of heating plant cover features, applications, quality of fuel used and capacity required. Oil, gas and coal firing are discussed with respect to each kind of equipment. Also described are the advantages of forced circulation and automatic controls involving the use of thermostats. Special applications of unit heaters and systems available are included for their particular field.

Design of fans covers their application in water and air circulating equipment. Two types of duct systems are included with sufficient data to apply to jobs which are not extremely large. Air washers for tempering and cleaning, filters for cleaning, compressors and evaporators for cooling and steam-jet apparatus for cooling are described. Central and unit air conditioning types are discussed in connection with required capacity. Also, design of "year-round" equipment for performing all the functions of air conditioning in both winter and summer is included.

Spotwelds in Multiple Steps

Welding 152 spots in one operation, this machine joins a back to a one piece wrap-around strip of steel forming the top and sides of the new Westinghouse refrigerator. The welds are made six points at a time. As the welding control mechanism operates, the electrodes seem to walk around the edges of the steel sheet forms. Electric power consumption is kept at lower current values by spot welding in multiple steps. The entire frame of the refrigerator is neatly and efficiently fabricated in this manner.



THE SCOTCH HAVE A VERSE FOR IT

Tender-handed stroke a nettle
And it stings you for your pains.
Grasp it like a man of mettle
And it soft as silk remains.

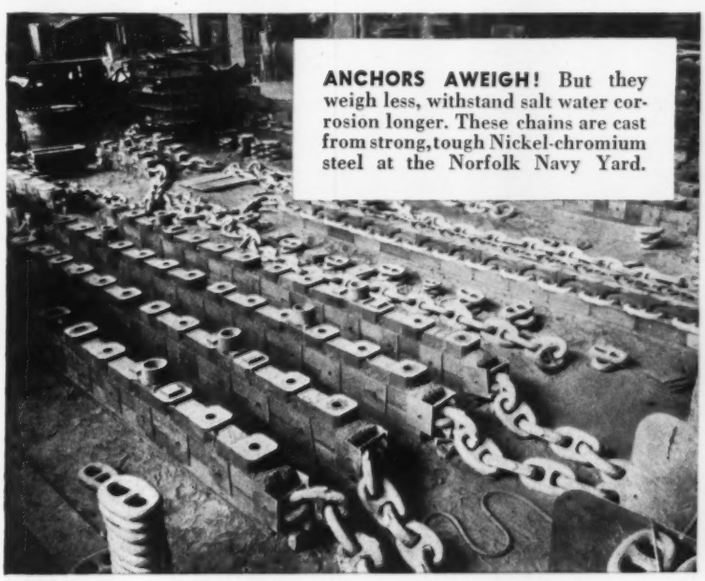
—old Scotch proverb

THIS YEAR, don't temporize. Don't try to get by with materials which were good enough in less competitive times. Use modern alloys containing Nickel to cut production and operating costs, reduce the heavy tax imposed by corrosion and wear.

Nickel helps each ounce and inch of metal do more work at lower cost per year. Nickel aids in solving many of the thorniest problems confronting you in 1939. The helpful suggestions of our research engineers, their practical experience in solving similar metallurgical problems for other businesses, are yours for the asking.

LANDSLIDES CLEARED QUICKER because this shovel is 28% lighter. Harnischfeger Corp., Milwaukee, makes it of a light-weight design using high-strength Nickel alloy steels.

NICKEL ALLOY STEELS



ANCHORS AWEIGH! But they weigh less, withstand salt water corrosion longer. These chains are cast from strong, tough Nickel-chromium steel at the Norfolk Navy Yard.

TWO POUNDER GRINDS AT 50,000 RPM! For the vitally important spindle of this fly-weight, air-driven grinder and die finisher the Onsrud Machine Works, Chicago, uses SAE 3135 steel toughened and strengthened with Nickel.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

NOTEWORTHY PATENTS

Combine Hydraulic Coupling, Converter

HYDRAULIC power transmission units embodying both hydraulic coupling and hydraulic torque converter with provisions for instantaneous shift from one to the other have been patented by Alf Lysholm and Fred Horney, Stockholm, Sweden. This patent, No. 2,142,199, has been assigned to Aktiebolaget Ljungstroms Angturbin, Stockholm.

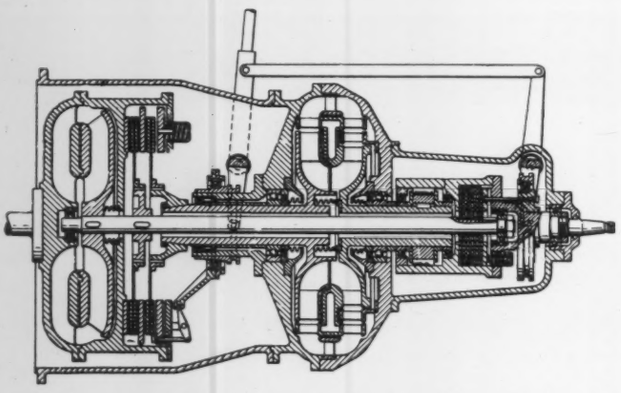


Fig. 1—Hydraulic transmission combines coupling and torque converter for independent operation of either

In *Fig.* 1 are shown the hydraulic transmission employing a hydraulic coupling, a hydraulic torque converter, two multiple-disk clutches and an overrunning roller clutch. Parts are so connected that either hydraulic unit may be used separately. With the clutch control lever in the position shown, the clutch at the coupling is disengaged and the drive is through the hydraulic coupling. The other disk clutch is engaged to provide direct drive to shaft.

Drives Through Overrunning Clutch

When the lever is pushed to the left reversing both disk clutch engagements, the torque converter is connected in the system. It then drives through the overrunning roller clutch, providing the required torque conversion. Driving through the converter in this way there is no relative motion between the parts in the coupling. Converter pump is driven by the clutch engagement with the coupling housing making it direct-connected with the driving shaft. Hydraulic elasticity in one or the other units eliminates the necessity of slipping the clutch for either operation of the clutch lever. Thus the clutches are able to transmit more power than would otherwise be the case.

Roll Changer Makes Accurate Splice

REFINEMENTS in web roll changers for rotary presses have been patented by Albert J. Horton and assigned to R. Hoe and Co. Inc. Control of roll changing such as bringing new roll into position, accelerating it to speed and joining new web are covered by patent No. 2,141,137.

The mechanism is relatively simple in operation as well as convenient in use. In the arrangement shown in *Fig.* 2, a second roll is ready for splicing. Operation of the hand lever brings the splicing mechanism into position for operation. A belt traveling at web speed accelerates the roll.

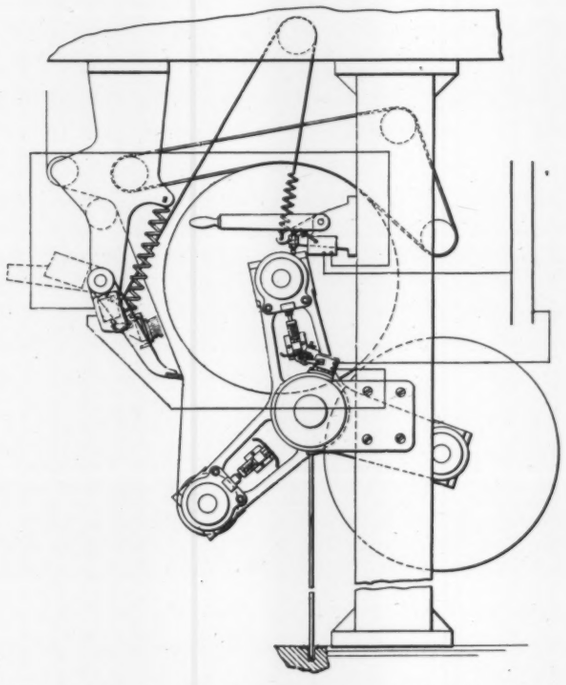


Fig. 2—Paper roll changer incorporates new timing features for making splices

With one side of an electrical circuit energized by the movement of the handle, the other becomes ener-

How to Avert Accidents and Prevent Breakdowns

Fig. 1645
Pat. App. for

Equip your machines with

UNBRAKO

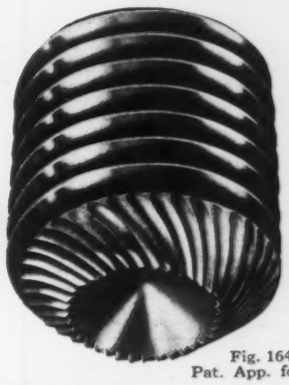


Fig. 1641
Pat. App. for

SELF-LOCKING HOLLOW SET SCREWS
with the Knurled Points

Here are the set screws that cannot loosen up in service . . . that cannot cause trouble by failing to perform their intended duty. So cleverly have they been knurled around the cup points that by merely tightening them in the normal way, they are securely and automatically locked in place. This not only eliminates the possible breakdowns that might follow a set screw's vibrating loose, but it makes frequent check-ups unnecessary.

Removal for adjustments is easily done with the customary wrench and the Knurled Self-Locker can be used again and again.

These "Unbrako" Self-Lockers have been carefully and thoroughly tested in many different plants and under varied conditions. The results substantiate our every claim.

Send the coupon for complete information and samples.

Fig. 1646
Pat. App. for

There's STRENGTH and DEPENDABILITY in the new Knurled Point UNBRAKO Self-Locking Square Head Set Screw

Industry has used and liked "Unbrako" Square Head Set Screws for years and now they, too, can be had with the automatic self-locking feature provided by the knurled cup points. These hold tight even under the most severe vibration but can be adjusted frequently, as desired, without impairing their locking effectiveness in the least.

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gized by the closing of a switch operated by a cam on the paper roll shaft. This cam is so positioned with respect to the adhesive on the roll that the energized circuit operates a solenoid on the splicing mechanism to glue the web at the precise position.

Through an electrical interlock, the roll for splicing is in proper position before splicing action can take place. This is accomplished by the cam switch shoe which must be in riding position. Such a cam arrangement is on each arm of the web reel.

Hydraulic Brakes for Bicycles

HYDRAULIC braking equipment for bicycles recently has been designed which contains the mechanism within the rear wheel hub. A longitudinal section of this device, covered by patent No. 2,141,967 is shown in *Fig.* 3. Patented by Charles Perry Ball Jr. and assigned to The Torrington Co. braking is applied by back pedaling the same as in conventional bicycle coaster-brakes.

Forward motion is obtained through a threaded sleeve on the sprocket assembly. Co-operating threads on a cone clutch hold it against a tapered bore in the hub. Reverse pedaling disengages this clutch member and forces together two spring-separated rings with faces serrated to prevent their turning. These rings in turn move forward a piston in the fluid chamber compressing the fluid area.

Through ducts the fluid extends two pistons in the brake-actuating cylinder which expand two pivoted

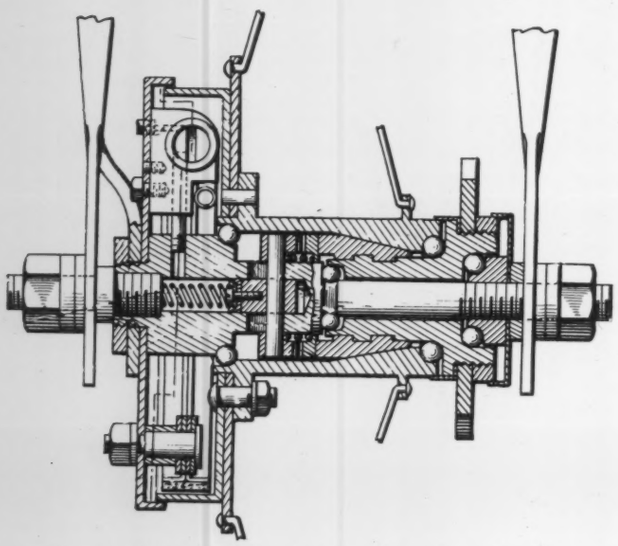


Fig. 3—Hydraulic brake is self-contained within the rear wheel hub of bicycle

brake shoes against a brake drum in proportion to the pressure exerted in back pedaling. This brake drum is larger than conventional designs to provide more radiating surface and prevent overheating on continued braking. Springs on the piston in the master cylinder and also on the brake shoes return the brake to normal position. The springs on the brake shoes serve to keep the system under pressure thus reducing seepage to a minimum and increasing the speed and efficiency of the braking operation. When necessary, fluid is replenished through a plug in the end plate.

The axle is bored from the end to make the hydraulic reservoir and master cylinder. Threaded into this bore is a stud to complete the axle shaft for mounting in the bicycle frame. The usual cone ball bearings are mounted at each side of the hub. In addition, the sprocket wheel assembly is provided with a set of similar bearings to increase the efficiency of the unit.

Automatic Dynamic Balancer Is Built-In

SELF-CONTAINED, hydraulically operated dynamic balancing units for mounting within a machine have been designed by Hans Ernst and Albert H. Dall. Patent No. 2,142,021 assigned to Cincinnati Grinders Inc., this balancer is useful for machines adapted for interchangeable tools on the spindle. A

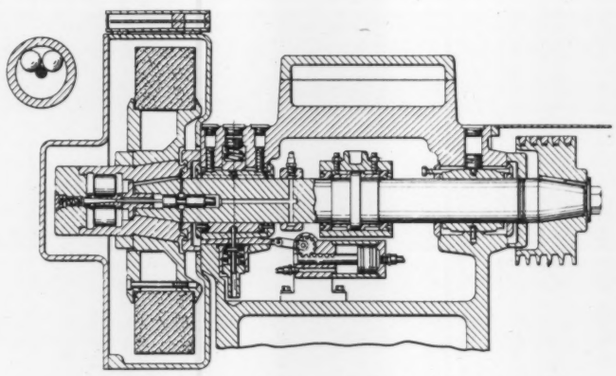


Fig. 4—Dynamic balancer is built into spindle, facilitating balancing of interchangeable heads

grinding machine head is shown in *Fig.* 4 incorporating this hydraulically operated mechanism.

When balancing is desired, a hydraulic rack and pinion withdraw a tapered key from the front bearing. This leaves the spindle free to vibrate within the bearing. Five springs on radial shoes provide freedom. In rotating in the unclamped position, the frequency of vibration of the mounting will be less than rotating frequency. Therefore the spindle will rotate with its light side out, facilitating this method of balancing.

Two roller weights in the head are normally held in place by tapered wedge and spring. During balancing, a hydraulic piston releases the wedge to allow the weights to roll toward the outside or light side. To prevent overtravel and oscillation, the weights are automatically released and clamped intermittently for very short periods of time. Thus they are allowed to creep slowly toward balancing position. The insert shows the weights in maximum position for correcting unbalance.

THERE ARE *40 inches* IN A DUMORE YARD

Here's an example of one step in the proven Dumore procedure to inject extra hours of power . . . regular testing of workmens' gauges with the microscopically accurate and costly Johansson blocks to assure precision in the finished product.

There's *longer value* in a "Dumore buy" largely because there are *more exacting methods* during Dumore manufacture. Better small motors are built only by better methods of designing, manufacturing, testing and by more painstaking, intelligent planning . . . . for as the size and weight of electric motors come down, the difficulties of production are multiplied in much greater proportion. That's why it's important to have men with long manufacturing experience build your small motors.

Most Dumore motors are designed for specific conditions . . . all are manufactured under highly developed special processes to give extra power hours. If yours is a problem of getting dependable power in limited space and weight, Dumore engineers can help you. Write today for latest information and free engineering service.

THE DUMORE COMPANY
Dept. 129-B **Racine, Wisconsin**

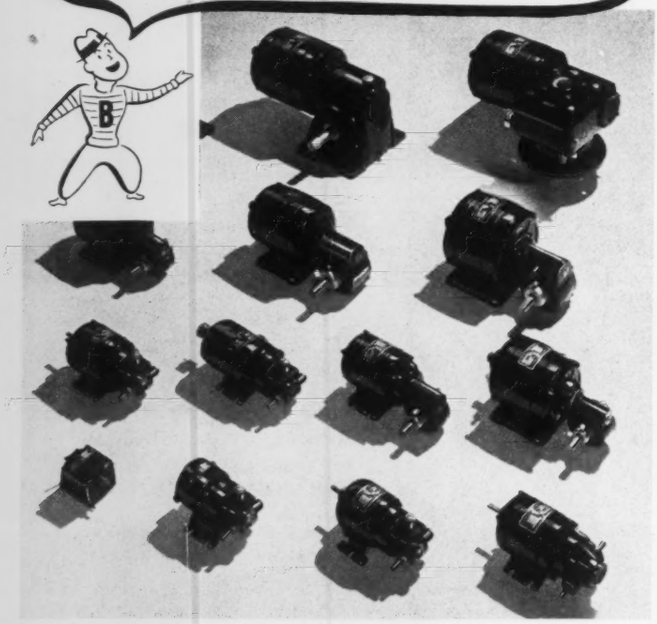
SPECIFICATIONS TYPE KD MOTOR

Series (Universal) 0-60 cycles; HP range, 1/25-1/75; full-load speeds 70-7 RPM; amperes, (115V.) 1.39; watts input, 148; duty, continuous; temperature rise, 40° C.; method of cooling, internal fan; bearings, composition bronze; housing cast iron; finish, black crinkle enamel; weight, 11 lbs.

DUMORE MOTORS

FOR *Extra* POWER HOURS

One of these BODINE SPEED REDUCER MOTORS will fit your Machine

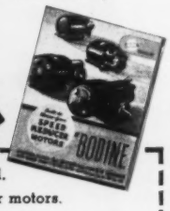


More than 1600 Standard Speed-Reducer Motors from 1/2000 to 1/6 hp

No matter what type or size of small fractional horsepower motor you may need, Bodine has a built-in speed reducer motor for the job. No other manufacturer offers so many standard types. Speeds range from 1 to 300 rpm, with torques up to 300 in-lbs. In addition, Bodine is equipped to adapt these standard motors to meet special requirements. Bodine speed reducer motors are compact and reliable. Their accurate permanent alignment guarantees silent and efficient operation.

Bodine also offers a complete line of fractional horsepower motors without speed reducers. Write today.

MAIL COUPON FOR BULLETIN!



BODINE

Bodine Electric Co., 2258 W. Ohio St., Chicago, Ill.

Please send me your new bulletin on speed reducer motors.

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Company.....

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BODINE MOTORS

ENGINEERED FOR YOUR PRODUCT

NEW Materials and Parts

(For Engineering Department Equipment see Pages 66, 74, 78)

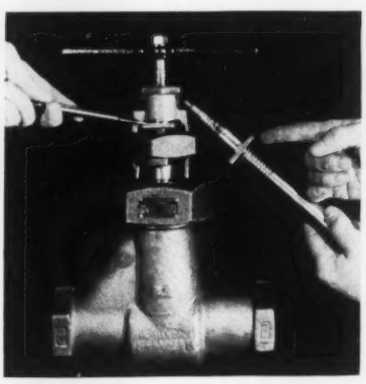
Counters Announced in Many Models

A NEW series of counting machines with streamlined, attractive gray crackle finish cases has been placed on the market by Durant Mfg. Co., Milwaukee and Providence, R. I. These counters, known as the Series H Productimeters, have oilless bearings, eliminating the need for regular attention and maintenance. Smoothness and accuracy in operating are further insured by cut gears. Visibility has been increased by using metal number wheels with large black figures on a white background, showing through louvred windows. The Series H Productimeters are made in 20 models and variations for efficient handling of any industrial counting or measuring problems.

Series of counting machines have oilless bearings and cut gears, insuring smoothness and accuracy

Valve Bushings Need No Lubrication

AN IMPORTANT design improvement in forged and cast steel valves has been announced by the Hancock Valve division of Manning, Maxwell & Moore Inc., Bridgeport, Conn. This advancement incorporates both the construction and materials used in a re-



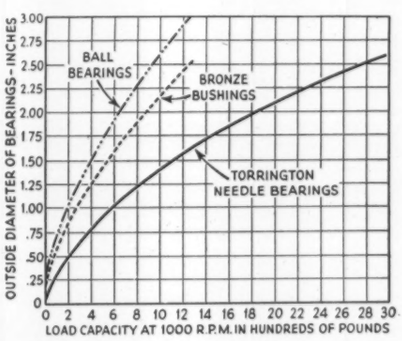
Design improvement in valves incorporates both the construction and materials used in a renewable stem thread bushing

COMPARE THE DIMENSIONS

of the TORRINGTON Needle Bearing

COMPARE from these graphs the outside diameters of the Torrington Needle Bearing with those of ball bearings and bronze bushings for comparable loads. Note the relatively small diameter of the Needle Bearing, and consider its space-saving advantages in your own products.

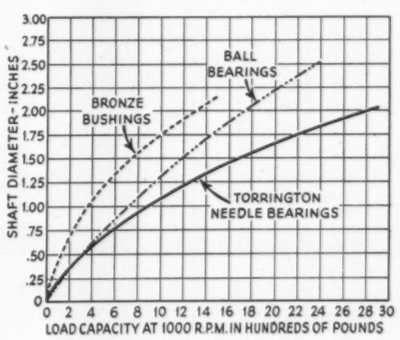
Note, too, the smaller shaft diameters needed to carry a given load with the



NOTE: Bronze Bushings to have same overall dimensions as Needle Bearings

Needle Bearing. These smaller dimensions mean savings in space, weight, and cost of surrounding members. Similar savings result at other operating speeds.

Moreover, the Needle Bearing allows additional savings because it permits the simplification of housing design. The bearing is a single compact unit, easily pressed into place in the simplest type of housing.



NOTE: Bronze Bushings to have same overall dimensions as Needle Bearings

A properly machined bore in the housing serves to mount the bearing.

Lubrication is Thorough

Lubrication of the Needle Bearing is efficient and thorough. The hardened outer retaining shell is provided with turned-in lips that hold ample quantities of oil or grease for long periods of operation without renewal. The rotation of the needles constantly provides lubricant for the rotating shaft. And all of these advantages are obtained in a bearing surprisingly low in both purchase price and assembly cost.

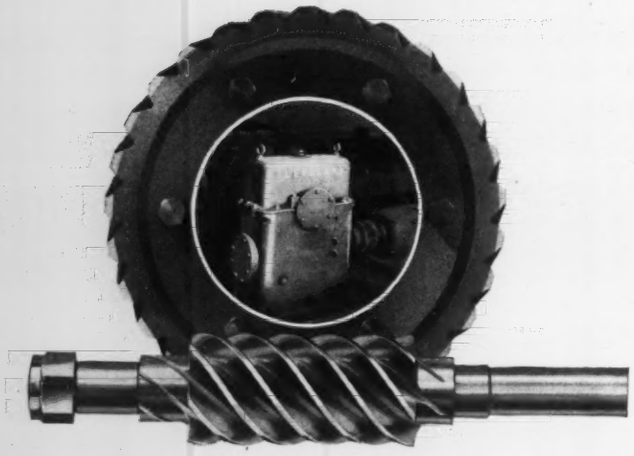
Why not secure these advantages in your own product? The Torrington Engineering Department will cooperate with you in laying out applications. For further information, write for Catalog No. 9. For Needle Bearings to be used in heavier service, request Circular X from our associate, Bantam Bearings Corporation, South Bend, Ind.

The Torrington Company
ESTABLISHED 1866
Torrington, Conn., U.S.A.

Makers of Ball and Needle Bearings

Branch Offices in all Principal Cities

TORRINGTON NEEDLE BEARING



Cleveland Drives Make Machines Pay Back Faster

CLEVELAND Worm Gear Drives will make the machines you build, pay back faster by protecting against costly shut-downs—by increasing productive hours. Even under the heaviest shock loads, Clevelands deliver a continuous flow of power, day after day throughout the years.

Twenty-seven years' experience in successful applications to the heavy machinery of American Industry have led plant executives to *expect more* from Cleveland Worm Gear Drives.

By their inherent ruggedness and dependability resulting in freedom from failure or need for repairs —and through long years of continuous service— Clevelands have kept faith. They *have delivered more!*

A Cleveland Engineer will show how you can make *your* machines pay back faster in savings for their owners, by helping you to plan the Worm Gear application best adapted to your job.

The Cleveland Worm & Gear Company, 3275 East 80th Street, Cleveland, Ohio.

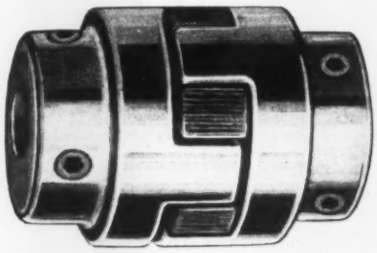
Affiliate: The Farval Corporation, Cleveland
Manufacturers of Centralized Systems of Lubrication

CLEVELAND WORM GEAR Speed Reducers

newable stem thread bushing. The part is now being made of Duronze (aluminum, copper, silicon alloy). These new bushings meet the demand for valves that will operate satisfactorily without lubrication of the stems at elevated pressures and temperatures. Abrasive particles may be picked up under these conditions if stems are lubricated. The new bushings have a low coefficient of friction, high resistance to wear and corrosion, and a tensile strength of 90,000 pounds. They can be replaced, thus saving the cost of a new valve stem and bonnet.

Coupling Handles Misalignment

A NEW flexible coupling for handling misalignment, starting torque, absorbing shocks, etc., on direct-connected machinery is announced by the Lovejoy Flexible Coupling Co., Chicago. The body of this flexible coupling is made of Tobin bronze, which will not spark under any conditions. The spider, or resilient load cushion is made from rubber, duck, leather



Flexible coupling is designed for handling misalignment and starting torque and for absorbing shocks on direct-connected machinery

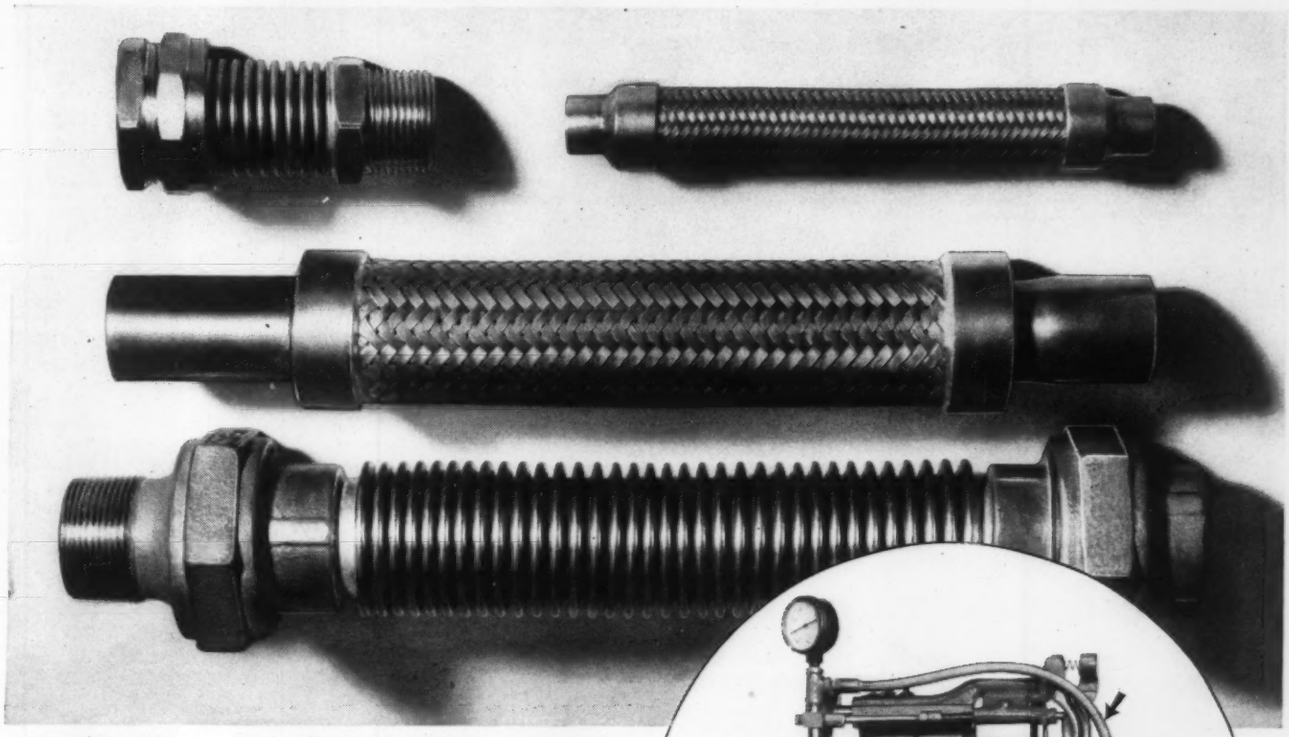
or a brake lining material of woven asbestos. Three-piece construction makes assembly and installation quick and easy. The spider member has sufficient resilience to safeguard the connected machines against overloads and misalignments. These couplings are made in the standard sizes with bores from 1-inch to 2¼-inch.

Variable Speed Pulleys Redesigned

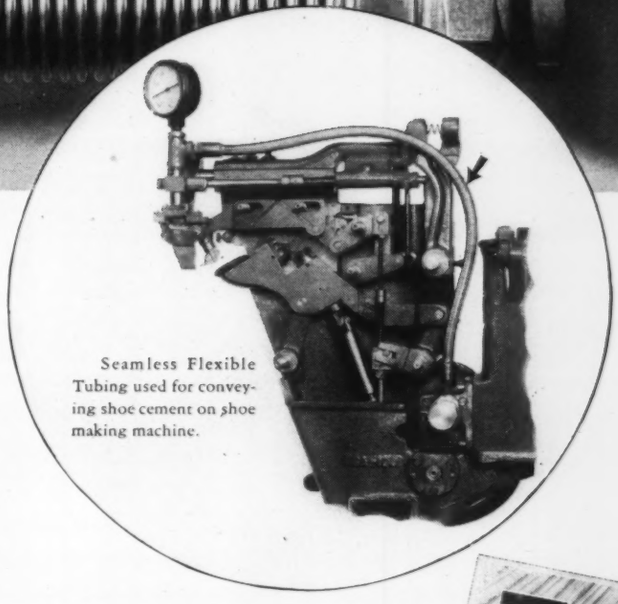
CONTINENTAL Machine Specialties, Minneapolis, announces an improved design of its Speedmaster pulleys, now infinitely variable in speed, molded of high impact strength Bakelite. An improved pressure-lubricated bronze sleeve allows the splined center sheave member to operate freely, regardless of load or speed. The new construction is available in two sizes: a 3½-inch diameter size for drives up to ½-horsepower capacity, and a 6½-inch diameter size for drives up to 3-horsepower capacity. The pulley is flexible in its adaptability to both straight line and angular drives. Interposed between motor and driven unit, the pulley's position can be changed to vary the center distances in relation to the drive and driven sheaves. Belts thus assume smaller or larger operating pitch diameters through the action of the vari-

Seamless *Flexible* Connectors

...THE SAFETY LINK BETWEEN TWO MOVING PARTS



Assemblies of American Seamless Flexible Metal Tubing with various types of end fittings used as leak-proof flexible connectors for taking up vibration, misalignment, etc.



Seamless Flexible Tubing used for conveying shoe cement on shoe making machine.

INSTALL American Seamless Flexible Metal Tubing as original parts on your product. It's cheap insurance against the need for future servicing. Wherever you need a flexible connector or conductor . . . for misaligned or moving parts, for absorbing vibration . . . the one best answer is American Seamless Flexible Metal Tubing.

There are no joints, welds, laps, seams or packing where leaks can occur. For the conveyance of air, water, oil, steam or fuel, this flexible tubing has no superior. That's why more and more designers of machinery of all types are putting "American Seamless" into their specifications.

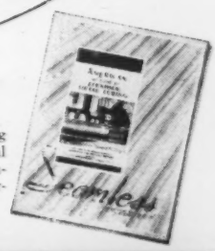
Write us about your connector problems. Our engineering department has a wealth of information on the use of "American Seamless" on all types of machinery. Consultation of this department entails no obligation.

39240

ANACONDA
from mine to consumer

FREE REFERENCE HANDBOOK ON SEAMLESS FLEXIBLE METAL TUBING

The most dependable *flexible* connector for conveying liquids or gases under high pressures...made from special *seamless* tubes of any workable metal. Handbook contains descriptions, illustrations and valuable engineering data. Write for Bulletin SS-3.



American Metal Hose

ANACONDA
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AMERICAN METAL HOSE BRANCH of THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Conn. • Subsidiary of Anaconda Copper Mining Company
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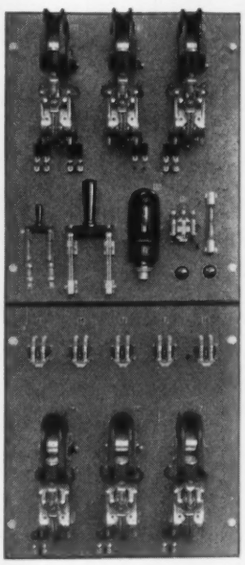
Variable Speed **TRANSMISSIONS**

able pulley faces. Control of speed is accomplished through a quick action lever, or a handwheel allowing control of speed within one revolution per minute. The entire unit is free floating so that belt alignment is accurately maintained at all times.

Controllers for Motor Acceleration

FOR automatically controlling the acceleration of alternating or direct current motors, a complete new line of starters and controllers using the Neo-Time acceleration has been announced by The Electric Controller & Mfg. Co., 2682 East Seventy-ninth street, Cleveland. The Neo-Time principle is based on the time required to charge a condenser to a predetermined voltage. When this voltage is reached, the condenser discharges through an industrial type neon tube to cause the first acceleration contactor to close. When this contactor closes, the same timing circuit is re-energized to close the next accelerating contactor and this operation is repeated until the motor is operating on full line voltage. One of the most important applications for this type of control equipment is in connection with drives requiring long time for acceleration. These include machines in which it has been necessary to provide special accelerating relays. The starter illustrated is for this type of drive and permits a range of from 3 seconds per acceleration step to over 30 seconds maximum per step, by simply turning the dial.



New line of starters and controllers is intended for automatically controlling the acceleration of alternating or direct current motors

Envelope Protects Prints

THE NEW Visulope announced by Curtis 1000 Inc., 1000 University avenue, St. Paul, is an envelope designed to afford positive and permanent protection to shop blueprints and work orders. It is made from a thermoplastic sheet and will withstand mois-

Vibration, shocks and strains are held at bay, and bolted parts are kept tight by the *long range* Live Action of Helical Spring Washers.

Bolts dare not loosen in these control assemblies! There is no substitute for the dependable effectiveness of Helical Spring Washers.

40 TONS IN ONE BITE!

Two and a half million pounds of steel swing into action! The 102-foot boom drives the dipper home . . . and 40 tons of rock and soil are casually tossed aside! Under this terrific strain only Helical Spring Washers can keep bolted parts tight! By exerting powerful, *maintained* pressure on thread surfaces the *long range* Live Action of Helical Spring Washers compensates for initial looseness caused by wear, scale, rust, breakdown of paint and bolt stretching. Be safe! . . . specify only Helical Spring Washers in *your* equipment.

SPRING WASHER INDUSTRY
616 WRIGLEY BUILDING · CHICAGO, ILLINOIS

ONLY A HELICAL SPRING **WASHER HAS LIVE ACTION!**

Makes a good Machine Better!

No machine tool can be better than its clutch. That's why every Twin Disc Clutch is engineered for-the-job—not merely to fit a machine. This assures the carrying of a machine's excellence of performance clear through to the job that it does. ¶ Extra in-built stamina enables Twin Disc Clutches to do as tough work as your machines themselves are capable of doing—to withstand sudden shocks—"to ride the clutch" when necessary—to withstand heavy overloads. ¶ Guard the reputation of your machines by standardizing on Twin Disc Clutches ... Write for recommendations.

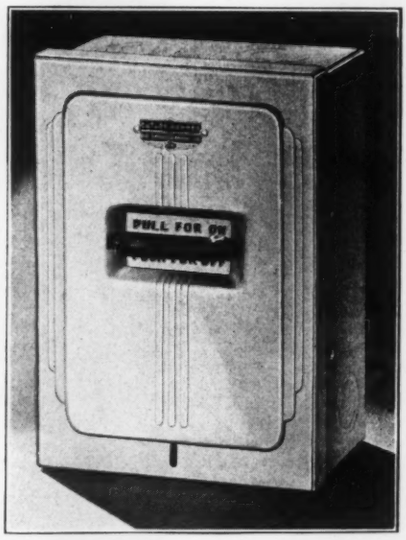
Warner & Swasey—long a consistent user of Twin Disc Clutches—equip their Universal Heavy-Duty Turret Lathe with a Model MT Twin Disc Clutch. Here the lathe is shown machining gear blanks from 6" bar stock.

TWIN DISC CLUTCH CO. • 1325 RACINE ST. • RACINE, WIS.

ture, oil and grease, will not stretch, shrink nor become brittle with age, and is nonflammable. Samples are available.

Announce Front-Operated Switch

NEWEST development of Cutler-Hammer Inc., Milwaukee, is the "D"-puller, a front-operated Type D enclosed switch. Rated at 30 amperes, the complete line consists of devices for 2 and 3-wire solid neutral service, and 2-pole, 250-volt switches. They are available with and without dead front plates.



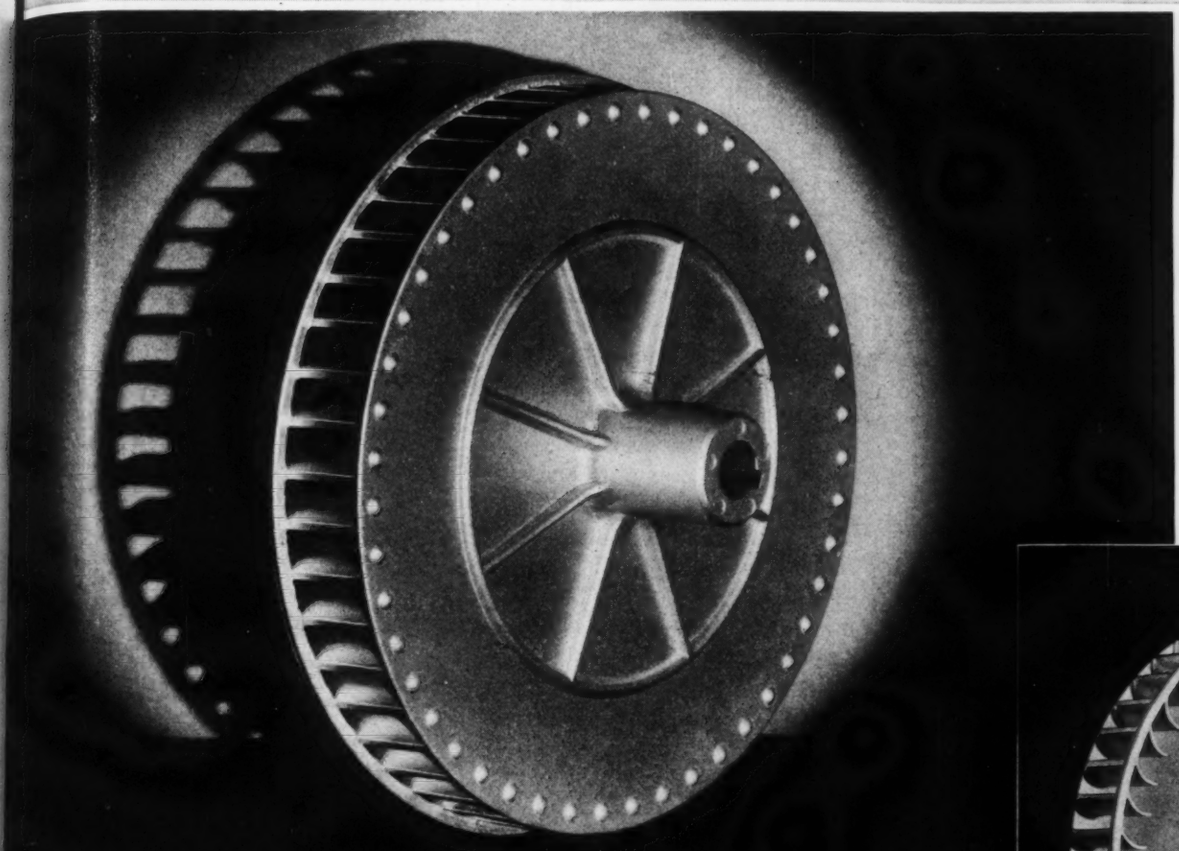
Front - operated enclosed switch, the "D"-puller, is intended for two and three-wire solid neutral service and two-pole, 250-volt switches

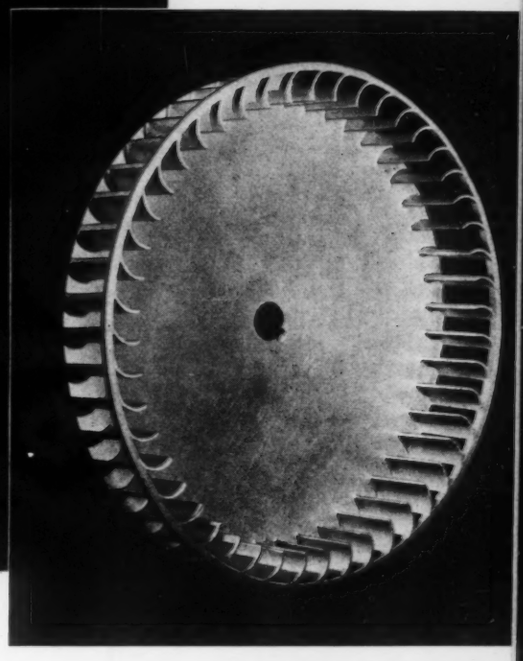
The simple switching mechanism of this line is operated on the "push-pull" principle by a sturdy Bakelite handle. Further aids to rapid installation are the solderless connectors on the line side, "easytite" wire holes on the terminal side and numerous, well-arranged knockouts. The Bakelite dead-front plate is easily removable with the fingers.

Plastic Absorbs Little Moisture

A NEW cellulose acetobutyrate plastic, Tenite II, has been announced by the Tennessee Eastman Corp., Kingsport, Tenn. It is claimed to have most of the advantages of both cellulose acetate and cellulose nitrate and almost none of their disadvantages. Depending somewhat on flow, Tenite II absorbs on immersion about the same amount of water as nitrocellulose plastic, about half as much as cellulose acetate plastic. Injection molding of Tenite II requires less pressure than is indicated by the flow designation. Up to a certain point flow increases uniformly with temperature, but beyond that critical temperature it flows considerably faster. The weld factor is markedly improved in Tenite II and is evidenced by improved strength and lack of flow lines in articles of relatively thick section. Because this plastic has a

ZINC ALLOY DIE CASTINGS





ONE PIECE
– The Ideal Construction

Here is the simplicity sought by every design engineer—in a rotor for a sirocco type blower. This part has been die cast *in one piece* from ZINC Alloy.

1. SIMPLICITY—As a die casting this rotor becomes a simple part, consisting of a hub with a flange having integral blades cast on one side. The blades are supported also by an integral ring, the inside diameter of which is equal to the diameter at the outside edge of the blades. Die casting is the ideal means of production in one piece—without excessive machining costs.

2. PERFECT BALANCE—Balance is all important for the vibrationless performance of this part. So essential is this requirement that the designers went one step beyond the inherent accuracy of the die casting process and provided small nibs around the outer edge of the flange. These nibs can be easily ground off as required in dynamic balancing to within 0.002 in. oz.

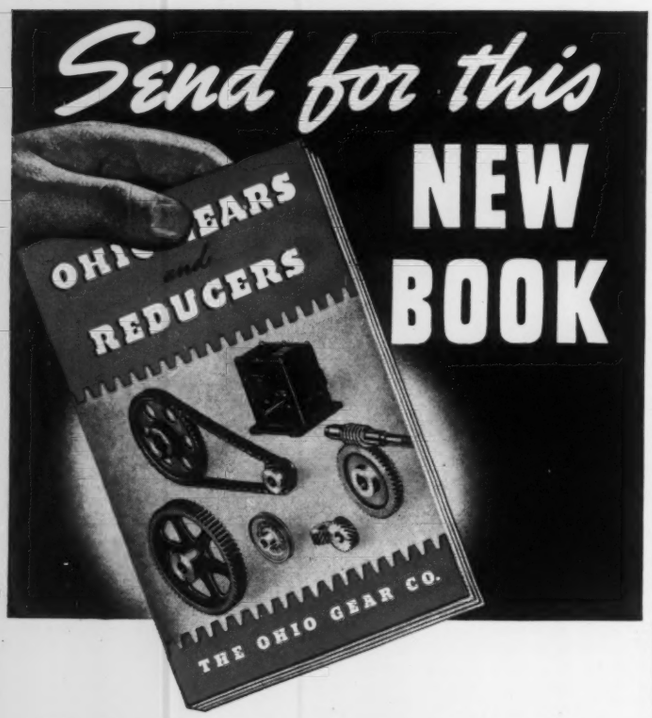
3. STRENGTH—The strength of this ZINC Alloy Die Casting is equal, or superior, to that found in most of the other common cast metals. The highest speed which the rotor attains in service is considerably below the maximum that the part will stand.

The simplicity and economy factors provided by ZINC Alloy Die Castings should be investigated. Consult any commercial die caster—or write to

THE NEW JERSEY ZINC COMPANY
160 Front Street New York

The Research was done, the Alloys were developed, and most Die Castings are specified with

HORSE HEAD SPECIAL (99.99+% UNIFORM QUALITY) ZINC



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Whether you design or maintain machinery you'll find this book helpful and informative. Complete, detailed information—on Stock and Special Gears, Speed Reducers, Pulleys, Chain and Sprocket and Power Transmission Equipment, engineering data and tables—right at your fingertips in this new 1939 Ohio Gear Book. And it's yours for the asking. Fill in Name and Company *and mail coupon today.*

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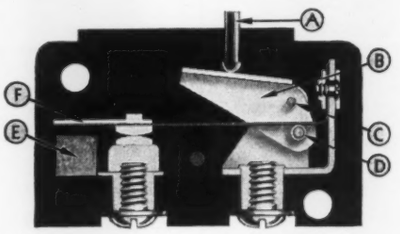
OHIO GEARS

critical temperature, it has much greater resistance to heat below the molding temperature.

Snap Switch Provides Wide Air Gap

A SWITCH action originally developed as a part of low water cut-offs, has been made the basis of a "snap" switch of the compact, low operating pressure, short-travel type, announced by McDonnell & Miller Co., Chicago. Basic consideration in design of the switch was a quick "make or break" with a wide air gap, while advantages of highly sensitive, short-movement operation were retained. In the illustration, plunger *A* acts on the lever *B* which is pivoted at point *C* so that the roller *D* communicates the operating action to the under side of the special alloy spring *F* on which one of the contacts is mounted. At

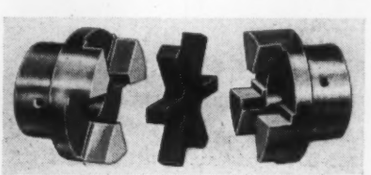


Basic consideration in design of snap switch was a quick "make or break" with a wide air gap

the end of the spring there is an iron armature which is attracted to the permanent magnet *E*. This magnet holds the switch in contact until the precise point is reached where the pressure on the spring overcomes the pull of the magnet. At this point the spring "kicks" to its upper limit instantaneously. When closing, the action is also immediate when the spring comes within the influence of the permanent magnet. The switch will operate on both direct and alternating current. Illustrated is the single pole, normally closed type, but the switch is made in normally opened type, single pole, double throw types, and other variations.

Develop Intermediate Coupling Sizes

GREATER horsepower ratings and larger maximum bores are provided in five intermediate sizes of the Bondtru flexible insulated coupling as a result of changes announced by Charles Bond Co., Phila-



Greater horsepower ratings and larger maximum bores are provided in five intermediate sizes of flexible insulated coupling

delphia. In the Bondtru, two metal flanges having projecting segments engage each other through a non-metallic insert, the arms of which carry the load in compression. Power-transmitting capacity is gov-

(*Continued on Page* 74)

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● You can *safely* leave *all* your sleeve-bearing problems with Johnson Bronze. Here you will receive the correct answers to your questions, the correct bearings for your applications and bearing performance in your product that has never been equalled. Specialization on our part — plus the most complete facilities available — enable us to give you the type of service; the uniform, quality product that you require.

The fact that we make *all* types of sleeve bearings enables us to give you sound advice, based on fact, free from prejudice. The fact that we specialize in making sleeve bearings — only — enables us to serve you with any type, in any size and of any quantity. Your most exacting specifications will be faithfully held, your delivery dates will be promptly made. Consult first with Johnson Bronze. It will save you both time and money.

Write for your copy of The Fundamentals of Sleeve-Type Bearings. A handy file folder containing a wealth of information on Bearings and their applications. There is no obligation.

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BRONZE CASTINGS ROUGH OR MACHINED

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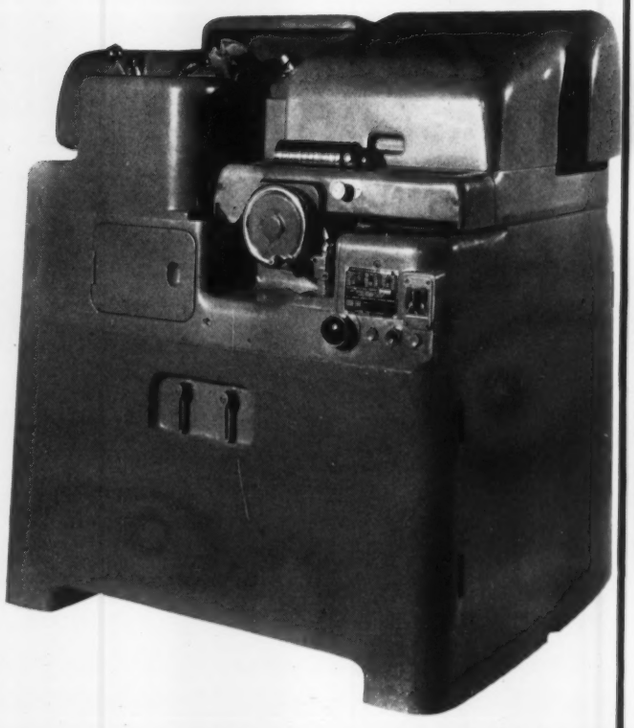
Machine Drives and

It's a far cry from the animal-powered machinery of the middle ages to today's smooth-running, automatic, power-driven, fully controllable machinery.

Every chief engineer and designer knows the value of proper selection of drives and controls, and is continually alert to factual information that will help him solve his problems.

MACHINE DESIGN for April will contain the Third Annual "Machine Drives and Controls" Supplement. All developments of the past year in machine drives and controls will be discussed in symposiums and comprehensive articles prepared by authorities on the subject.

Watch for "Machine Drives and Controls" in the April issue.



MODERN INDUSTRY DEPENDS ON MACHINERY...

...controls

*Have Kept Pace too**...

Information available from no other source will be presented concisely and completely in the Supplement. It will in fact be an engineering data-book filled with readily usable information.

How design of machinery will be affected by improvements in drives and controls, and a symposium of design problems in relation to noise level reduction in drives, are but two of the principal subjects that will be considered in addition to those enumerated below.

Contents Will Include Discussions of . . .

V-BELT, COTTON BELT AND LEATHER BELT DRIVES
PHOTOELECTRIC AND OTHER VACUUM TUBES
HYDRAULIC CYLINDERS AND VALVES
ELECTRIC MOTORS OF ALL TYPES
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MAGNETIC DRIVES
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CONTROLLERS
SOLENOIDS
RHEOSTATS
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. . . and comprehensive discussions of their applications and combinations, written for the benefit of chief engineers and designers who select and specify machine drives and controls in the design and redesign of machinery.

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* Advertising pages will include additional specific information on Machine Drives and Controls and will add considerably to filable engineering data . . . Manufacturers should make their space reservations early to assure best possible positions.

. . . MACHINERY DEPENDS ON DRIVES AND CONTROLS

Putting a new design tool in your hands

● If you have a "white elephant" in the form of a tough problem of design long unlicked . . . if you feel the stubborn unyieldingness of conventional power means—try a new avenue of approach. Investigate thoroughly the unlimited interest and applicability of Oilgear Fluid Power.

Oilgear may give your machine a new motion . . . a new function, a new controllability of power or a surprising flexibility of its application—results that may mean a new high advantage in competitive markets. You will be surprised to know the great designers who already are taking advantage of Oilgear's *applicability* . . . and the results *they* have achieved. Start your investigation of this new tool *now*. THE OILGEAR COMPANY, 1321 West Bruce Street, Milwaukee, Wisconsin.

OILGEAR

Fluid Power

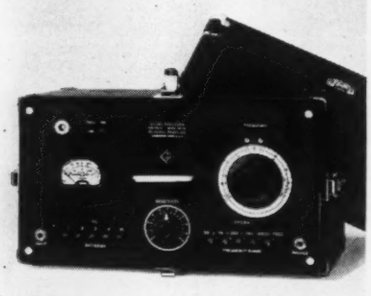
VARIABLE SPEED SYSTEMS

(*Continued from Page 70*)

erned by both the outside diameter of the coupling and the total load-bearing surface of the insert. The five intermediate sizes have been redesigned to employ inserts with six radiating arms, providing three driving points of contact, instead of the former four-arm insert which provided only two driving points of contact. This 50 per cent increase in load-bearing surface of the insert is said to have resulted in appreciable increases in the horsepower ratings of these five sizes. Another innovation in the Bondtru line is the offering of the ¼-horsepower size (B-11) in 38 different lengths, ranging from 1 9/16-inch to 5 11/16-inch.

Sound Analyzer for Machine Noises

TYPE 760-A sound analyzer announced by General Radio Co., Cambridge, Mass., was designed particularly for analyzing the noise and vibration generated by machines, motors, appliances and other mechanical and electrical equipment. The analyzer consists of a degenerative, selective amplifier and logarithmic vacuum tube voltmeter. The response frequency can be varied between 25 and 7500 cycles by means of a rotary dial and a set of pushbutton switches. Usable output indications can be obtained



Sound analyzer is used in connection with reduction of noise and vibration generated by machines, motors, appliances

with inputs ranging from 1 millivolt to 10 volts. The meter scale is calibrated for reading directly component tones down to 1 per cent of the sound pressure of the fundamental or loudest component. The whole assembly is portable. This sound analyzer is intended for use in conjunction with the General Radio sound level meter, but it can also be used with any microphone or vibration pickup and amplifier combination which provides sufficient output voltage.

Relay Is Automatic, Self-Contained

THE Microtrol relay announced by the Weston Electrical Instrument Corp., Newark, N. J., is a completely automatic, ultra-sensitive controller, entirely self-contained. Control units—sensitive relay, power relay and clock motor—are housed in a plug-in type glass case. Permitting removal of the working mechanism without disconnecting any wires, the front housing offers ease of maintenance. The Micro-

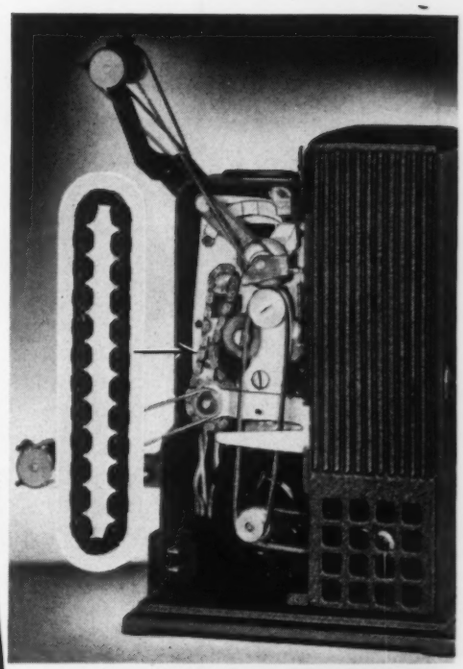
3/16" PITCH MORSE CHAINS

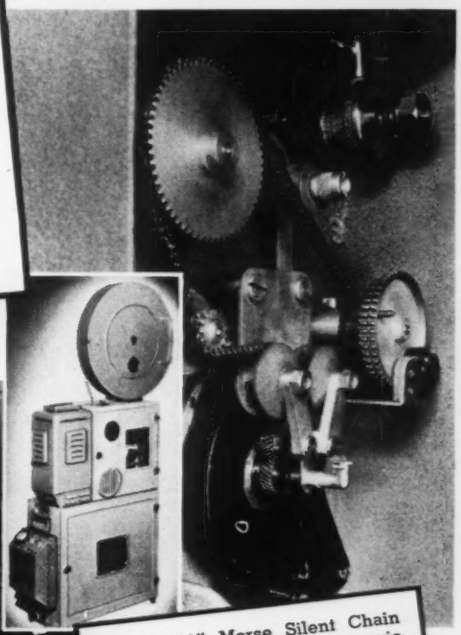
GOT a fractional horsepower driving job? Need a special chain application in miniature? Worry no more—your answer is a Morse Silent Chain.

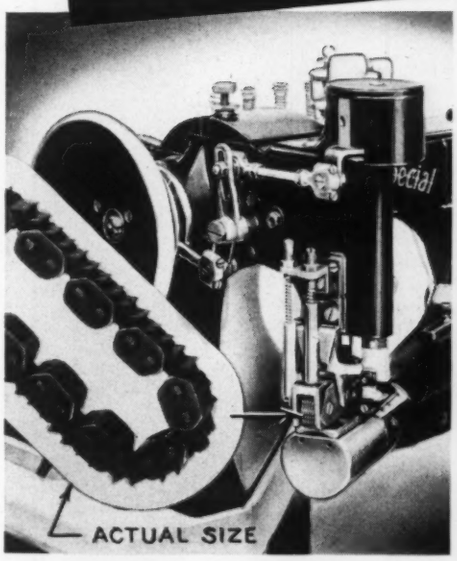
Morse $\frac{3}{16}$" pitch chains have been used for years in many special applications; have proved their effectiveness time and time again.

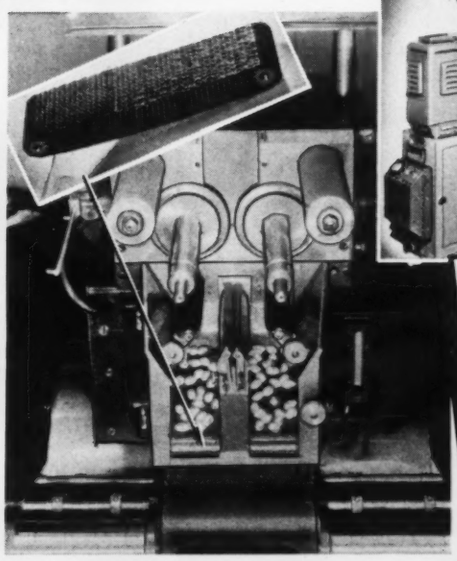
Like their larger, heavier brothers (Morse Silent Chains are built up to 5000 h.p. capacity) the $\frac{3}{16}$" pitch Morse Silent Chains transmit power steadily, smoothly, and with greatest efficiency. Service is measured in a succession of trouble-free years. Maintenance consists of occasional lubrication. Wear is at a minimum, performance hits new highs.

Investigate Morse Silent Chains for your small drives. Our engineering staff is at your service. Or ask the nearest Morse representative.









Top—3/16" Morse Silent Chain insures perfect timing on movie projector.

Above—Tiny Morse 3/16" Silent Chain drives this movie camera with complete dependability.

Extreme Left—This chain, shown actual size in inset, does a special job well.

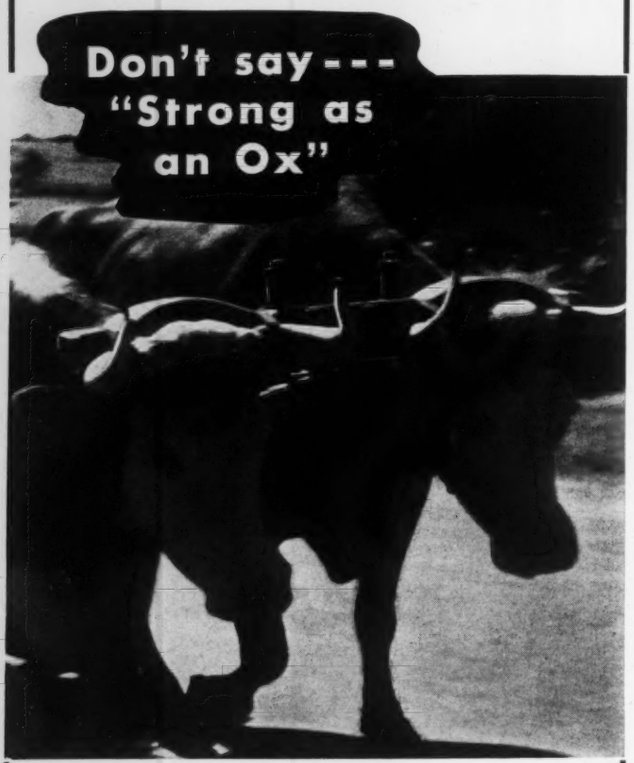
Left—Here is 3/16" pitch Morse Silent Chain used as carriers on a gelatine capsule making machine.

SILENT CHAINS ROLLER CHAINS FLEXIBLE COUPLINGS KELPO CLUTCHES

MORSE *positive* DRIVES

MORSE CHAIN COMPANY ITHACA N. Y. DIVISION BORG-WARNER CORP.

FOR GREATER EMPHASIS



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There you have the last word in similes for strength. The years of experimentation with new and improved alloys, plus continuously bettered methods of heat treating, has resulted in amazing tensile strength and in hardness. For every purpose where a socket screw is needed, you can be certain of getting 100% satisfactory service by specifying "Unbrako".

Ask for full details about the complete line.

Right—Fig. 1434—Knurled "Unbrako" Socket Head Cap Screw. The neat, sure-grip head provides distinctive advantages.

Left — Fig. 232 — "Unbrako" Hollow Set Screw. Industry's favorite for years because they do not crack or mushroom even under tough service.

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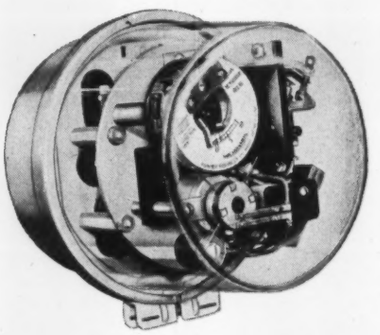
BOX 102

BRANCHES CHICAGO ST. LOUIS SAN FRANCISCO

trol relay is designed for an operating interval in which the power relay will open and close once each four seconds. The relay will remain closed approximately three seconds and open one second. These

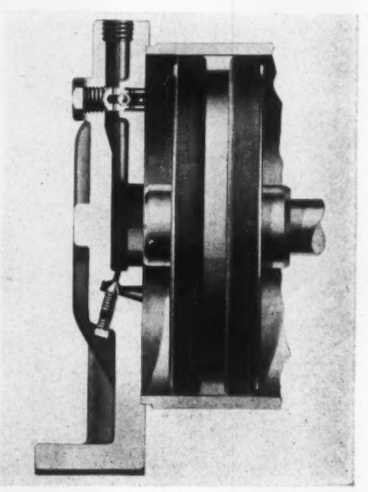


Microtrol relay is completely automatic, ultrasensitive, entirely self-contained

time intervals can be changed on special order. Microtrol relay is intended for use on 120-volt, 60-cycle circuits, although for special requirements the relay can be supplied for any commercial frequency at voltage ranges from 12 to 250.

Adjustable Automatic Air Cushion

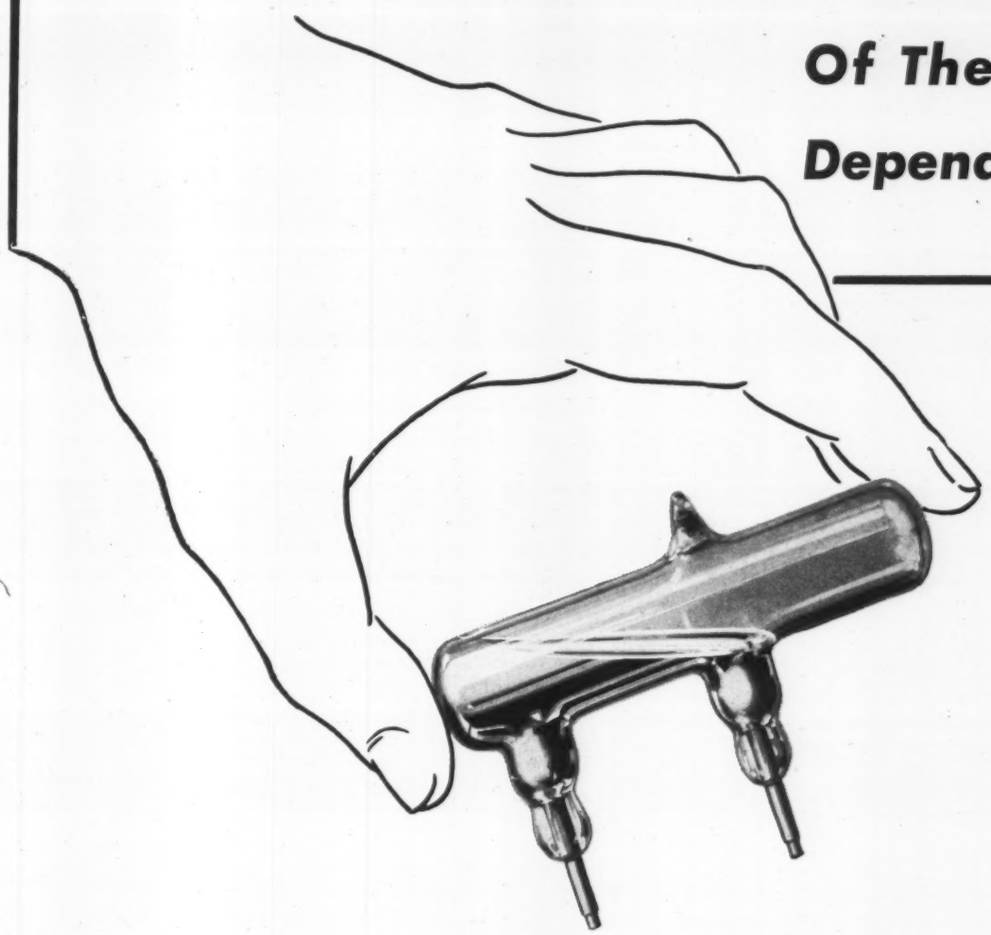
FOR AIR cylinders, a cushioning arrangement just developed can be adjusted to meet the variables of air velocity, stroke and relation of cylinder capacity to load. The cushioning, announced by the Hanna Engineering Works, Chicago, is entirely automatic once adjusted. As the cushion sleeve enters the cylinder head the air trapped between the piston and the cylinder head forms a cushion. Thereafter the speed



Cushioning arrangement for air cylinders can be adjusted to meet variables of air velocity, stroke and relation of cylinder capacity of load

at which the piston continues to the end of its stroke is controlled by an adjustable needle valve. Upon reversal of the piston travel the ball check valve permits live air to act upon the full area of the piston. Air cylinders embodying this new development are available in diameters of from 2-inch to 20-inch inclusive. Where heavy loads and long stroke are involved, modi-

"LIKE SILENT WATCHMEN... Of The Utmost Dependability"



KON-NEC-TORS

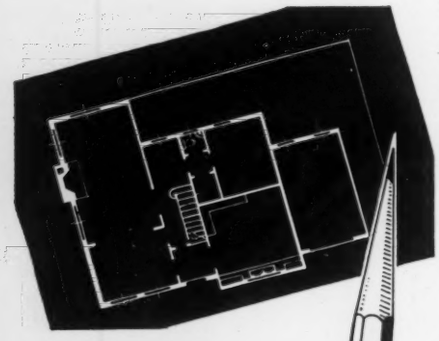
"General Electric KON-NEC-TORS supply the automatic features," said this manufacturer, "and are like watchmen standing by to stop the machines the minute trouble arises. They perform their tasks with the utmost dependability. In most cases our machines could not be produced successfully without them."

Dependable service is characteristic of KON-NEC-TORS. These fool-proof, wear-proof and maintenance-free switches are ideal where utmost reliability and long life are essential. A clean make-and-break is always assured. Corrosive fumes and moisture cannot harm these switches, ever.

There's a KON-NEC-TOR of the type and capacity to suit your needs. Write for complete informative new Bulletin or have one of our representatives call and give you the facts. General Electric Vapor Lamp Co., 825 Adams Street, Hoboken, New Jersey.

GENERAL ELECTRIC VAPOR LAMP COMPANY

861K



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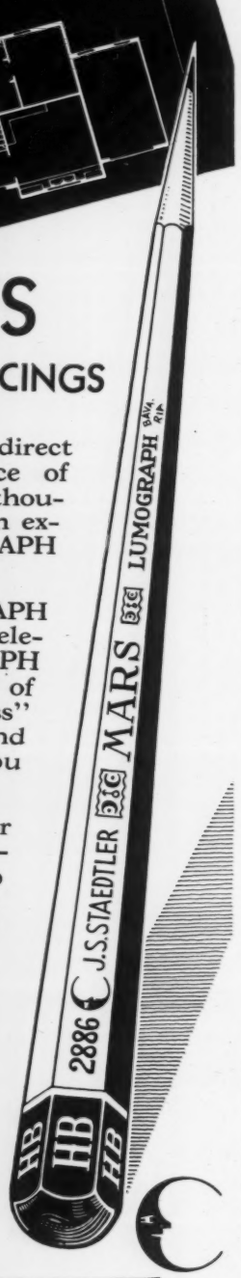

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fications of the cushion illustrated provide greater cushioning area and stroke. In addition to the cushion control, such cylinders are equipped with speed boxes to control the full piston travel.

White Printer Combines Developer

LIKE the Model E machine announced in *M. D.*, January, p. 67, the Model D white print machine brought out by Ozalid Corp., New York, is a complete duplicating unit in itself, combining printing and developing. The operator, who need not be skilled, merely feeds the original and the sensitized Ozalid material into the front of the unit, after which it is exposed to the light of a mercury vapor lamp and is dry-developed by exposure to ammonia vapor. The developer feed board is located immediately over and

Model D white print machine is a complete duplicating unit, combining printing and developing

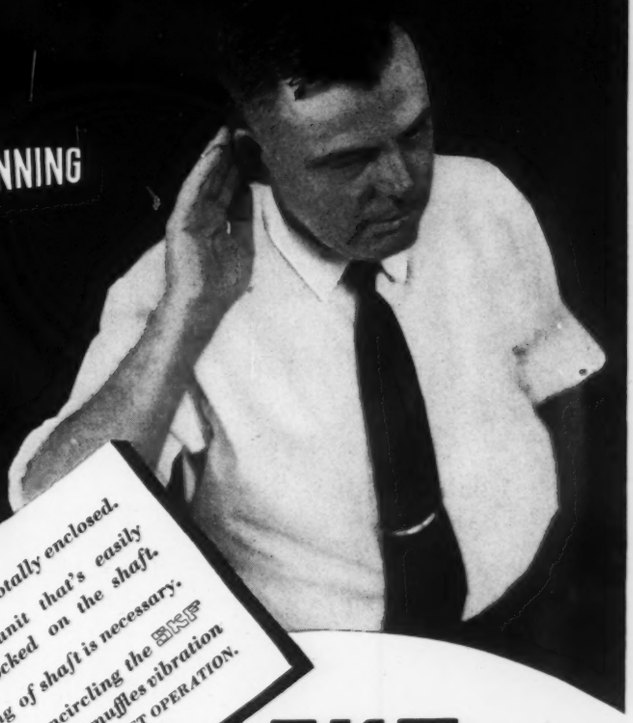
behind the print return tray of the printer. The machine is driven by a ¼-horsepower resilient-rubber mounted split phase motor, and the speed adjustment of the printer is infinitely variable. A speed indicator for the full speed range is located on the front of the unit. All air entering the cylinder for cooling the mercury vapor tube is filtered to cut down dust deposits on the tube within the glass cylinder. Constant cleaning is hence not necessary.

Heavy Pintles Aid Flow in Valves

THE NEW 1H Warco-Benedek series of variable displacement pumps made by the W. A. Riddell Corp., Bucyrus, O., include variable and reversible delivery, smooth and quick operation up to very high pressures. An extra heavy valve pintle increases rigidity and facilitates easy flow of liquid. Pintle and barrel are confined to concentric relationship with small operating clearance and low slippage by double capacity roller bearings. Self-contained shaft mounting and alignment between pintle and drive shaft is insured also by double row extra capacity bearings for the drive shaft. A cut-away type shifter ring assures

New!

YOU HARDLY KNOW IT'S RUNNING



1. Self-contained. 2. Totally enclosed. 3. A self-aligning unit that's easily slipped and locked on the shaft. 4. No machining of shaft is necessary. 5. A rubber ring encircling the SKF Grip-Lock Bearing muffles vibration noises and insures QUIET OPERATION.

SKF Rubber Flex PILLOW BLOCK

No longer do vibration noises impair the quiet operation of fans and other equipment. For SKF has developed a pillow block that *muffles* vibration noises.

This latest development — the SKF Rubber Flex Pillow Block — is equipped with an SKF Grip-Lock Bearing in a RUBBER RING to assure quiet operation. It is designed to isolate completely the rubber from the bearing, and provision is made on both sides of the bearing to permit additional lubrication. Effective seals protect the bearing. Send for descriptive sheet. SKF Industries, Inc., Front St. and Erie Ave., Philadelphia, Pa.

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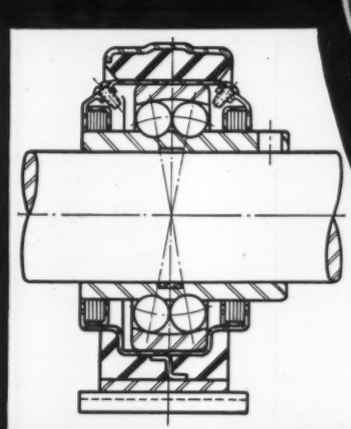


SKF

BALL & ROLLER BEARING

PILLOW BLOCKS

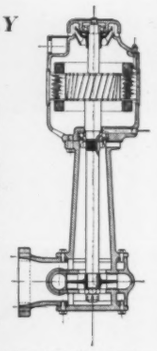
THE GUSHER COOLANT PUMP

A PRECISION BUILT COOLANT PUMP

ELIMINATING UNSIGHTLY EXTERNAL PIPING

Model No. 11020A

Easily mounted, full ball bearing equipped, HYDROSTATICALLY BALANCED, self-cleaning, increased effciency. Designed for the safe handling of materials that contain grit and abrasives.



Model No. 11022 Patented and Patents Pending

QUIET

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THE RUTHMAN MACHINERY CO.

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Precision Screw— Threads,

Can be *accurately* ground *out of the solid AFTER HARDENING*

Thus made, distortion errors are corrected and the threads are *clean*, *smooth*, held to *very close* limits and concentric with axis. These elements are extremely important in high speed spindles and numerous other shafts requiring *true* threads on which a nut can be drawn up "dead square". If you have such problems, consult —

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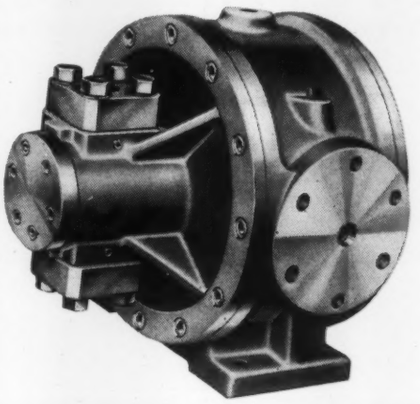
free and sufficient cooling of the rotary reactance through radiation. Stroke control is centralized and balanced. Lubrication by a high pressure, wedge-

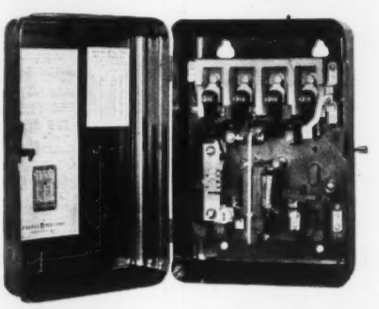


Extra heavy valve pintles in new series of variable displacement pumps increase rigidity and facilitate easy flow of liquid

shaped oil film bath for the reciprocating crosshead provides maximum efficiency and shock-absorbing qualities.

Switch for Single Phase Motors

A NEW magnetic switch has been announced by General Electric Co., Schenectady, N. Y., for use with single phase motors. Available in ratings of 3-horsepower at 110 volts, 5-horsepower at 220 volts, and 7½ horsepower at 440 volts, the new device consists of a standard general-purpose 4-pole magnetic



New four-pole magnetic switch with two poles connected in parallel equivalent to a two-pole switch with one overload relay

switch with two poles connected in parallel. This arrangement makes it equivalent to a 2-pole switch with one overload relay. Application of the switch is limited to single phase motors whose normal full load current does not exceed 30 amperes.

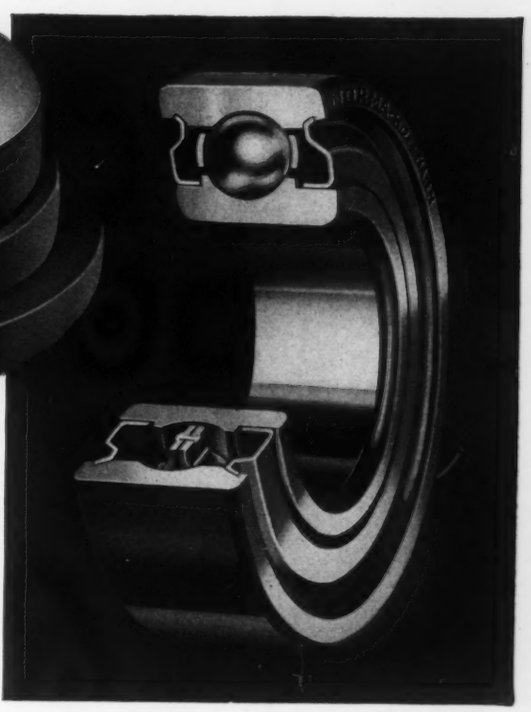
Announce Hydraulic Action Controls

SOLID liquid-filled hydraulic action thermal systems form the basis of a new line of controls announced by Julien P. Friez & Sons, division of Bendix Aviation Corp., Baltimore. This hydraulic action system is sealed permanently both in respect to sensitive element and switch. The switching mechanisms are extremely heavy, with high load-carrying capacity of 25 amperes at 120 volts, 15 amperes at 240 volts,

AT 17,000 R.P.M.

"NORMA-HOFFMANN"
PRECISION BEARINGS

INSURE SPEED, POWER AND DEPENDABILITY



Describing its Hand-ee Hi-Power Portable Grinder, here pictured, the Chicago Wheel and Manufacturing Co., (Chicago, Ill.) says:—

"High speed precision ball bearings, fully protected with seals to keep lubricant in and dust out, reduce friction and consequent wear to an absolute minimum—assure maximum power delivery."

The bearings used are NORMA-HOFFMANN "9000" Series Self-Sealed Precision Ball Bearings employing a non-rotating, inwardly extending flanged metal seal. They not only afford PERMANENT PROTECTION without drag or frictional resistance but also provide LARGER GREASE CAPACITY and effectively RETAIN THE LUBRICANT IN HORIZONTAL OR VERTICAL POSITION, WITHOUT ANY FRICTION, WEAR, OR LOSS OF POWER WHATSOEVER.

Nothing less than PRECISION, in the NORMA-HOFFMANN sense, could account for such successful performance. For over a quarter of a century, NORMA-HOFFMANN have been the preeminent high speed PRECISION BEARINGS.

The NORMA-HOFFMANN line embraces 108 distinct series with over 3000 sizes of PRECISION Ball, Roller and Thrust Bearings. Write for the Catalog. Let our engineers work with yours on your difficult bearing problems.

NORMA-HOFFMANN BEARINGS CORPN., STAMFORD, CONN. U.S.A.

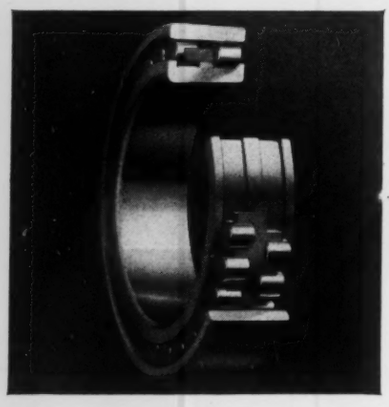
alternating current. The fan or warm air limit switch, illustrated, has fast sensitivity, adjustable differential.

Hydraulic action systems form basis of new line of controls, and are sealed permanently

It is available in simple or combined forms, including two speed types for either three or five-lead motors.

Bearing Has Light Section Races

THE new double-row cylindical roller bearing developed by SKF Industries Inc., Philadelphia, is notable for its light section giving a large bore and a small outside diameter—a desirable advantage when space is at a premium. It was developed primarily

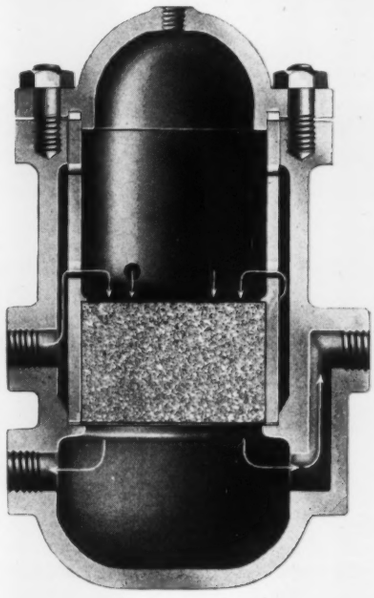


Its light section, giving a large bore and small outside diameter, makes double-row cylindrical roller bearing desirable when space is at a premium

for the machine tool industry, but can be used successfully in other fields. The large number of cylindrical rollers maintained in a staggered position by the bronze cage permits high radial capacity.

Filters Utilize Aluminum Oxide

NEW filters, types 360 and 361, developed by the Fisher Governor Co., Marshalltown, Iowa, remove foreign matter and separate free moisture from air and gas pipe lines with a minimum friction loss. These filters utilize extremely hard aluminum oxide crystals bonded together as a filter element. The element resists both acids and heat, while permitting gases to pass through it with a minimum loss caused by friction. They may be installed in either vertical or horizontal pipe lines with standard pipe fittings.



New filters remove foreign matter and separate free moisture from air and gas pipe lines with a minimum friction loss

Flanged and bolted bottom castings permit easy removal for cleaning.

Variable Speed Drives Announced

NEW precision variable speed drives have been announced by The Oilgear Co., Milwaukee, type DT being illustrated. This comprises a standard fluid power transmission with micro servomotor stroke control cylinder to adjust the pump stroke to give the required hydraulic motor speed. Oil is admitted

Precision variable speed drive comprises a standard fluid power transmission with micro servo-motor stroke-control cylinder

to this cylinder by a pilot valve, actuated by a small differential unit which continuously compares the hydraulic motor speed with time, or with the speed of any desired master unit. Each unit drive may be controlled directly by a small synchronous motor or pendulum to give absolute speed in revolutions per minute, or by any master unit or roll stand when a precise speed ratio with another unit is required.

The simplicity . . . the double break, silver alloy contacts that never require attention . . . the generous wiring space . . . the millions of operations built into the Bulletin 709 solenoid starter have made it a favorite of machine tool manufacturers.

ALLEN-BRADLEY

BULLETIN 709 SOLENOID STARTERS

QUALITY

The Secret of Allen-Bradley Solenoid Starter Performance

Only ONE MOVING PART

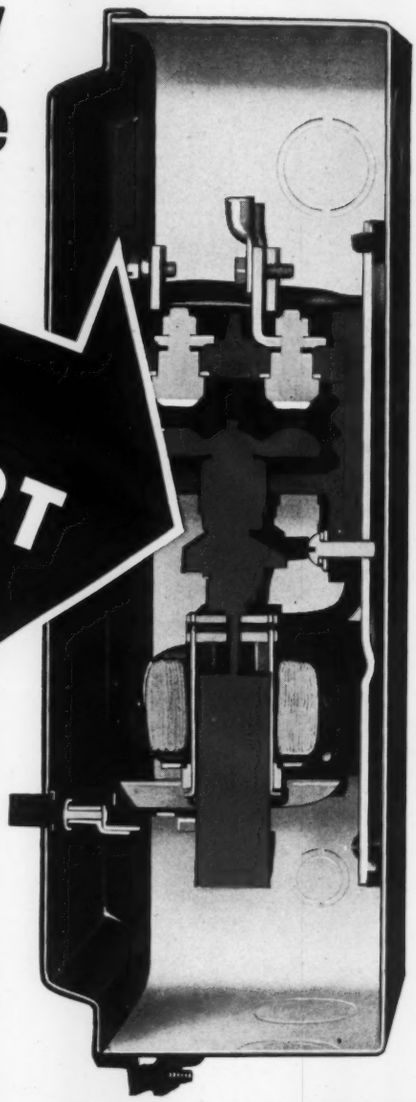
In the Allen-Bradley starter, the movable contacts are connected directly to the solenoid plunger—the starter's only moving part. The plunger slides freely in its phosphor bronze guide. Friction-producing parts have been eliminated. There are no complicated mechanisms or flexible jumpers. That's why these starters provide millions of trouble-free operations.

NO PIVOTS-PINS-BEARINGS in Allen-Bradley Solenoid Starters

Trouble due to dirty, corroded, or sticky pivots or pins, or delayed bearing action has been done away with. Designers of high speed machine tools can safely take advantage of this starter's precise and consistent operation.

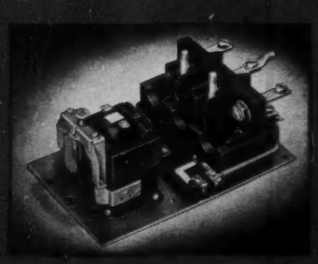
Furthermore, you never need to clean or file the double break, cadmium silver alloy contacts on Allen-Bradley solenoid starters. Valuable contact life is not wasted. Maintenance expense is saved. And, these are not the only advantages of the Allen-Bradley solenoid starter! Write for booklet.

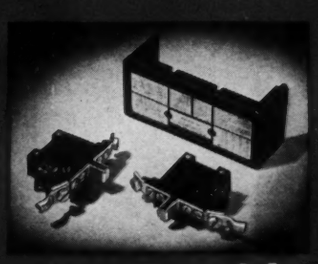
Allen-Bradley Co., 1333 S. First St., Milwaukee, Wis.



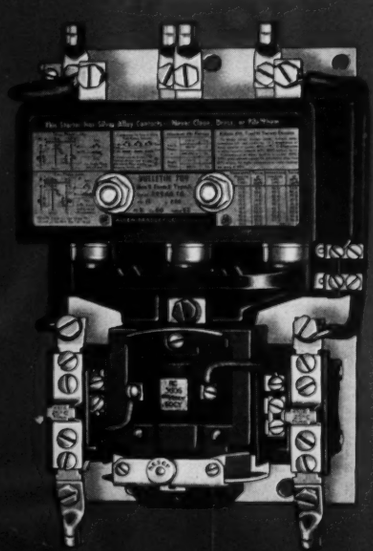
Cut-away view of the Allen-Bradley solenoid starter. Contacts and solenoid plunger form the only moving part.

This Basic Unit + **This Movable Contactor** + **Two Relays and Arc Hood Cover** = **Allen-Bradley Solenoid Starter**





Such Simple Construction Prevents Trouble



Bulletin 709 Solenoid Starter for across-the-line motors. Can be furnished in any one of seven different enclosures

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL

Tiny Engine Design

(*Concluded from Page* 46)

the use of a pointed steel wire which is threaded into the upper end of the tube. This wire works against a small spring and its adjustment controls the flow of gasoline into the cylinder, and thus the engine speed.

A second tapped hole in the top of the receptacle carries a threaded cap which is removed to permit filling with gasoline. Capacity of the fuel reservoir is less than 1 ounce, but sufficient to operate the engine for several minutes. A race lasts only about 30 seconds, and thus ample fuel supply is available.

Piston and connecting rod assembly are permanent mold aluminum alloy castings. Of the conventional design with step-type head, the piston has two 1/32-inch slots for piston rings, and bosses for mounting a bronze wristpin. Wall thickness of the piston is slightly over 1/64-inch, and two ⅛-inch holes are drilled just below the wristpin holes to permit passage of intake gases into the crankcase.

Measuring only 1-9/32 inches from hole to hole the connecting rod will withstand a maximum straight pull of 632 pounds. A bronze wristpin .001-inch oversize is press fitted into the piston, the latter being heated to insure a good fit. There is no bearing on the lower end of the rod except the softer aluminum alloy on the steel pin. Lubrication of cylinder walls and bearings is provided by mixing one part oil with four parts gasoline in the fuel. No other oil is maintained in the crankcase.

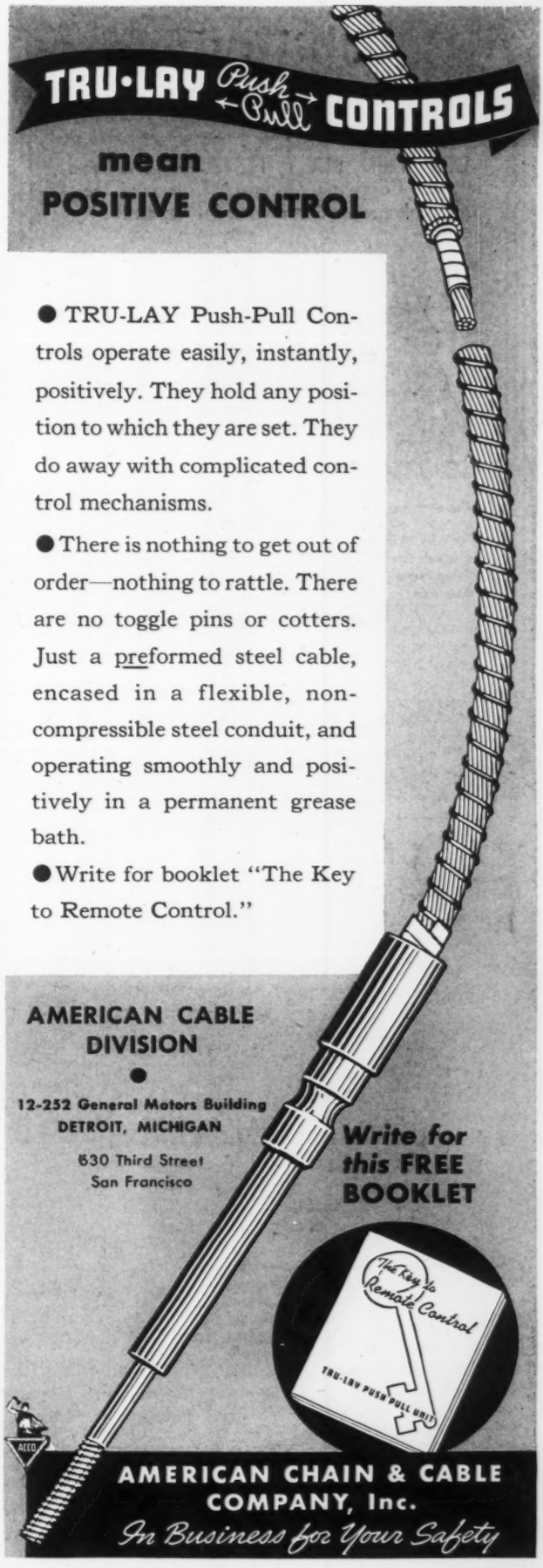
Piston Rings Made of Cast Iron

Piston rings, made specially, are of cast iron 1/32-inch in section and are produced round, then split, placed over a mandrel and heat treated.

The commutator housing is stamped from 17ST rolled aluminum alloy and is formed with a collar which fits over the boss on the front half of the crankcase. A fiber post carrying one breaker point is held by a bolt through the upper part of the commutator. The other contact is attached to a piece of steel bent at right angles and attached to a short piece of spring steel in such fashion that the contacts are held closed except when the protruding end of the right-angle piece is lifted by the revolving cam on the shaft directly below it. Advancing or retarding the spark is accomplished by radial movement of the entire commutator housing.

A small spark coil and 3-volt battery are required to supply spark to the engine. Special types of ignition coils have been developed, weighing only 1¾ ounces. Batteries are dry cells.

Because of their small size, these tiny engines offer an interesting design study. Every effort necessarily is made to keep weight down to an absolute minimum and at the same time to produce an engine that can be placed on the market at an economical figure.


TRU-LAY Push ← Pull → CONTROLS
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POSITIVE CONTROL
● TRU-LAY Push-Pull Controls operate easily, instantly, positively. They hold any position to which they are set. They do away with complicated control mechanisms.
● There is nothing to get out of order—nothing to rattle. There are no toggle pins or cotters. Just a preformed steel cable, encased in a flexible, non-compressible steel conduit, and operating smoothly and positively in a permanent grease bath.
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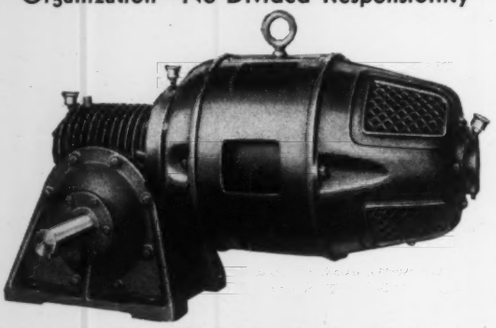
Janette

MOTORIZED SPEED REDUCERS

10 DIFFERENT STYLES
DESIGNED, BUILT, TESTED—Guaranteed as a Complete, Compact Unit, by One Organization—No Divided Responsibility



Illustrating Type RW4—Single reduction—Worm gear—Reducer driven by a Janette Slip Ring Motor

The diversity of the Janette custom built line of motorized speed reducers enables us to supply a machine from 1/50 to 7½ H.P. for almost any purpose. You can select the style of compact, rugged Janette speed reducer that meets your individual requirements, without the necessity for using expensive adaptors or modifications.

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Rotary Converters—Generators—Motors—Motor-Generators

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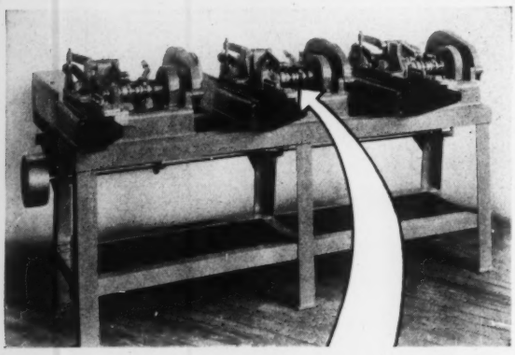
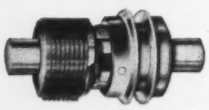
PULLMORE CLUTCHES
GIVE TOP PERFORMANCE
In Sleeper and Hartley Machines





Single-type Pullmore

Pullmore Clutches are giving "very satisfactory" service in Sleeper & Hartley Wire Straightening and Cutting Machines. Three single-type Pullmore Clutches operating dry at 200 r.p.m. are used in the machine illustrated for starting and stopping three units independently. Pullmore Clutches are used because they are reliable, compact, durable; quickly and easily adjusted when this eventually becomes necessary. Pullmore Clutches are equally effective in a wide variety of other automatic and semi-automatic machines, cranes, machine tools and similar equipment. Complete information about Pullmore Clutches, many illustrations of applications, dimension and capacity data are contained in the Pullmore Blue Book which will be sent free on request. Write for your copy today.

ROCKFORD DRILLING MACHINE DIVISION
Borg-Warner Corporation, 304 Catherine Street, Rockford, Illinois
Sold by MORSE CHAIN CO., Ithaca, N. Y. With offices in principal cities

Topics

(*Concluded from Page* 26)

the cross-arms. Hence waves sent out over these bars are concentrated near the ground, instead of being spread in all directions.

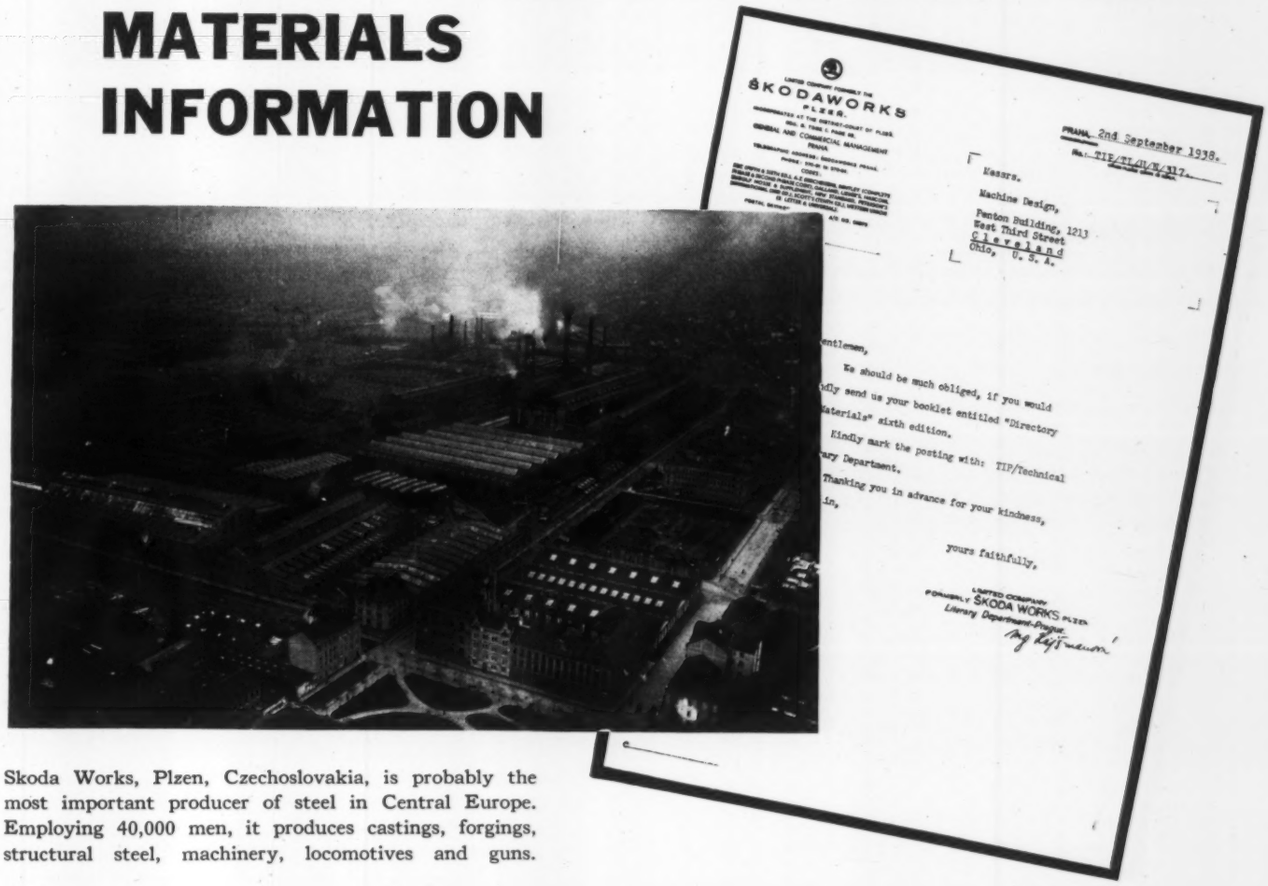
♦

MASS production of airplanes is imminent, with wings and fuselage of a new plastic known as Duramold, developed by the Haskelite Corp., Chicago and Clark Aircraft Corp., Hagerstown, Md. The material is lighter than aluminum, yet its strength-weight ratio was found by the Bureau of Standards to be excellent. A wing or fuselage can be turned out in two hours with the labor of only nine men, it was said. This time is between one-twentieth or one-thirtieth of that ordinarily required. A detailed description of the process has not been divulged, but it was explained many strips of long-grained wood were impregnated with Bakelite, than formed in dies which cast a complete section of fuselage or wing. Fuselage, for instance, is cast in two parts subsequently glued together, with reinforcing spars glued from the inside. Because of the more perfect streamlining obtainable, the process is said to make possible as much as 35 extra miles per hour in speed.

♦

INTERESTING uses are continually being found for a form of colloidal graphite, so finely divided that it will pass through filter paper and can be suspended in suitable volatile liquids during applications to friction surfaces. The film of graphite left after evaporation of its liquid carrier is very thin, but it provides lasting "dry" lubrication. Graphite particles are so minute they are not scraped off in service, but rather become embedded in the surface of the metal parts treated. Recently this method of lubrication was used in the divisional shafts and adjacent lapped parts (bearings) in orifice type flow meters for gas under pressures up to 50 pounds per square inch. Gas leakage, obviously, would cause corrosion of the static spring and result in meter failure. Moreover, gumming of the lubricant by the hydrogen sulphide in the gas would retard meter action and destroy accuracy. Electric furnace-produced colloidal graphite suspended in pure castor oil was found to provide a sealing action for the parts mentioned, without mechanical pressure means. Small mechanical devices such as locks, fire alarm systems, telephone exchange equipment, news tickers, small motors, etc., have had their parts "dry" lubricated satisfactorily in similar fashion. Conveyor chains which run through the high temperatures of ovens for enameling and baking also have been lubricated in this way.

CZECHOSLOVAKIA'S GIANT SKODA WORKS comes to "MACHINE DESIGN" for MATERIALS INFORMATION



Skoda Works, Plzen, Czechoslovakia, is probably the most important producer of steel in Central Europe. Employing 40,000 men, it produces castings, forgings, structural steel, machinery, locomotives and guns.

Important and progressive machinery manufacturing plants must keep thoroughly posted on developments in materials. Like the Skoda Works, American manufacturers consider MACHINE DESIGN's Directory of Materials an invaluable reference book for their design departments.

Orders for this, the Sixth Edition of the Directory of Materials have exceeded all expectations. As the supply of copies now is limited, we urge that orders be sent immediately.

Requests for additional copies should be accompanied by a purchase order, check or money order. No postage necessary.

SPECIAL RATES ON QUANTITIES HAVE BEEN ESTABLISHED

1 copy	$ .25 each	$	.25
10 copies	.20 each		2.00
25 copies	.18 each		4.50
50 copies	.16 each		8.00
100 copies	.15 each		15.00

MACHINE DESIGN

A Penton Publication

CLEVELAND, OHIO

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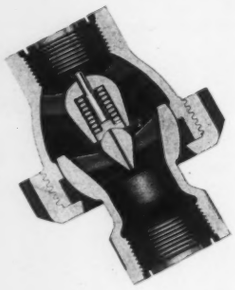
CENTER SPRING—STREAMLINED

FLEXIBLE BALL JOINTS

Stainless steel spring shrouded for protection against fluids, corrosion and erosion.

Spring pressure against ball in exact center, providing equal pressure of ball against gasket seat in all positions with minimum friction.

Automatic adjustment.



Catalog 320 will give you the complete details

Barco Manufacturing Co.

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DID YOU TRY RAYMOND FOR THOSE SPRINGS?

Designing Springs for high temperatures, high speeds, to meet corrosive conditions . . . . these are jobs for the experienced springmaker. If you have problems in spring design, RAYMOND has the experience and engineering brains to solve them

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WIRE FORMS
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Meetings and Expositions

Feb. 23-25—

American Society of Mechanical Engineers. Spring meeting to be held at St. Charles hotel, New Orleans, La. Concurrently there will be held the annual meeting of the Louisiana Engineering Society. C. E. Davies, 29 West Thirty-ninth street, New York, is secretary.

March 6-10—

American Society for Testing Materials. Regional meeting to be held at Deshler-Wallick hotel, Columbus, O. W. W. Heimberger, Buckeye Steel Castings Co., Columbus, is arrangements committee chairman.

March 7-10—

American Road Builders' association. Thirty-sixth annual convention and highway exhibit to be held in Civic auditorium, San Francisco. Additional information may be obtained from the association, National Press building, Washington.

March 8-9—

Air conditioning conference to be held at University of Illinois under sponsorship of department of mechanical engineering and the engineering experiment station of the College of Engineering.

March 8-10—

International Acetylene association. Thirty-ninth annual convention to be held at Rice hotel, Houston, Tex. Additional information may be obtained from the association, 30 East Forty-second street, New York city.

March 13-16—

American Society of Bakery Engineers. Annual meeting to be held at Edgewater Beach hotel, Chicago. Victor E. Marx, 1541 Birchwood avenue, Chicago, is secretary.

March 14-16—

American Railway Engineering association. Annual meeting to be held at Palmer House, Chicago. W. S. Lachery, 59 East Van Buren street, Chicago, is secretary.

March 14-18—

American Society of Tool Engineers. Annual meeting and Machine Tool Progress exhibition to be held at Convention Hall, Detroit. Ford R. Lamb, Room 428 Boulevard Temple building, 2567 West Grand boulevard, Detroit, is executive secretary.

MANUFACTURERS' *publications*

ALLOYS (STEEL)—Economy is emphasized and castings and cut-gears made of Neloy alloy steel are fully described in an 8-page, illustrated bulletin No. 6, issued by National-Erie Corp., Erie, Pa. Action photographs show applications of both light and heavy duty gears and castings in unusual industrial jobs.

BRONZE—Many of the unusual properties of Sabeco bronze, arising out of its virgin metal content, are discussed in an illustrated, highly readable booklet issued by the Fredericksen Co., Saginaw, Mich. Lasting qualities, less friction, easy machining and absence of impure hard spots are points emphasized.

CONTROLS (ELECTRICAL)—An illustrated leaflet published by Westinghouse Electric & Mfg. Co., East Pittsburgh, discusses De-ion nonreversing linestarters with built-in control circuit transformers, designed for use on stokers, oil burners, and other applications where a low voltage control circuit is desired for safety and economy.

CONTROLS (ELECTRONIC)—Title of a new 11-page booklet published by United Cinephone Corp., Long Island City, N. Y., is "Marvels of the Electric Eye," discussing the principles of photo-electric control, progress in the field, many possible applications.

CONTROLS (PUSHBUTTON) — In handy, usable form, a complete discussion of pushbutton units for built-in mounting is included in a leaflet just issued by General Electric Co., Schenectady, N. Y. Along with illustrations of the units are concise descriptions and diagrams. Specifications, dimensions and prices are given.

DRIVES (CHAIN)—Data contained in book No. 1645, published by Link-Belt Co., Chicago, is specifically intended to be of help in designing drives for gasoline, oil, diesel and steam engines. Engineers will find useful the information on laying out efficient, durable driving connections between crankshafts, camshafts, fanshafts, generators, magnetos, compressors, blowers, etc.

ENGINES—Models C-33 and A-33, single cylinder engines, water and air-cooled, resepectively, are described in bulletins Nos. 35 and 36, published by the Novo Engine Co., Lansing, Mich.

FILTERS—Title of an unusual, conveniently arranged booklet published by Cuno Engineering Corp.,

P&H HIGH EFFICIENCY ELECTRIC MOTORS

An outstanding record in the industry is that of P&H High Efficiency Electric Motors, which have proved themselves so dependable that the total cost for service and repairs is less than 1% of gross sales! That is one good reason why motor users have come in increasing numbers to take advantage of the superior design and construction in P&H High Efficiency Motors. P&H electrical engineers will gladly discuss your motor applications without cost or obligation. Harnischfeger Corporation, 4556 W. National Avenue, Milwaukee, Wis.

Convertible Slip-Ring and Squirrel-Cage Motors up to 250 h.p. capacity. Literature on request.

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For "Close Quarters" Use The Sturdy, High Capacity MICRO SWITCH

LK LIMIT SWITCH

3¼" x 1 13/16" x 1"

1—Movement Differential 0.001" or less.

2—Pretravel of actuator plunger to operating point, 0.010".

3—Overtravel of actuator plunger beyond operating point 7/32".

4—Distance between operating point and C. L. of 3/16" dowel pin holes held to ±.003".

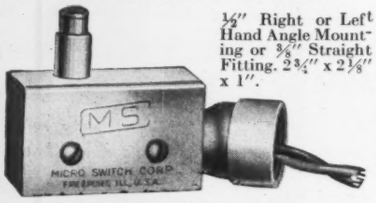
1/4" OVERTRAVEL METAL CLAD SWITCH

1—Movement differential under .0005".

2—Operating pressure about 8½ oz.

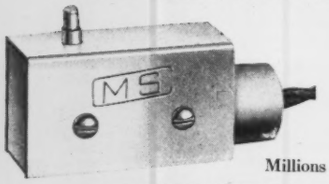
3—Overtravel of actuator plunger beyond operating point ¼".

4—Heater loads 1200 watts up to 600 volts A.C. Also inductive loads, solenoids, and relays, ½ H.P. up to 460 volts A.C.



⅛" Right or Left Hand Angle Mounting or 3/8" Straight Fitting. 2¾" x 2⅛" x 1".

1/16" OVERTRAVEL METAL CLAD SWITCH



1—Heater loads 1200 watts up to 600 volts A.C. Also inductive loads, solenoids, and relays. ½ H.P. up to 460 volts A.C.

2—Operates on 0.001" movement, 14 oz. pressure.

3—Can be used in any position—vibration-resistant.

4—60 or more snaps per minute. Millions of operations. 2 5/8" x 1 3/16" x 1 7/32"

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Tuthill Small Pumps are engineered to deliver maximum capacity at minimum power cost. Power requirements are today the lowest in Tuthill history. Another reason why design engineers specify these dependable small pumps. Capacities from ⅓ to 3 g.p.m. Pressures up to 400 lbs. per sq. in.

TUTHILL PUMP COMPANY

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Meriden, Conn., is "80 Ways to Make More Money." It consists of discussion of 80 actual cases of Cuno continuously cleanable filters at work in industry, indexed in three divisions: Process, Power, and Heavy Industries. Of special interest to MACHINE DESIGN readers is a section devoted to the design engineer who works in all these fields.

FINISHES—New Wrinkle Inc., Dayton, O., has issued the second number of its publication, "New Wrinkles in Finishing," discussing the nature, applications, and possibilities of New Wrinkle, a versatile surface finish.

HOSE (FLEXIBLE)—Engineering data of interest to designers is included in a new profusely illustrated catalog, G-14, issued by Chicago Metal Hose Corp., Chicago. Rex-Weld corrugated metal hose, Rex-Tube asbestos packed hose and other types are discussed and couplings are recommended for each type. Bound into the center of the book is a new products section in color, describing new diesel exhaust hose, Aviolex, a hose for oil connections, and stainless steel bellows.

HYDRAULIC CYLINDERS—Revised bulletin No. 35-A has been published by Hannifin Mfg. Co., Chicago, giving a number of illustrations and dimensions of different types of hydraulic cylinders for various standard mountings, and with small diameter piston rods, differential piston rods, and double end piston rods. Of particular interest is the information on hydraulic cylinders with adjustable cushion on either or both ends.

INSTRUMENTS—The Roller-Smith Co., New York, announces catalog 48-A covering its complete line of 3 and 4-inch, round and square, alternating and direct current, ammeters, milliammeters, microammeters, voltmeters, single and polyphase wattmeters and pyrometers.

MOTORS—The Louis Allis Co., Milwaukee, has prepared a condensed 8-page booklet, No. 610, including general information on NEMA standards and definitions. Helpful suggestions are given for the proper selection of motors and types of drives. There is also useful information regarding service factors, rated loads, torques.

MOTORS—Hoist and crane motors designed to meet exacting electrical and mechanical requirements of frequent starting and stopping, are discussed in a 4-page illustrated leaflet recently published by Westinghouse Electric & Mfg. Co., East Pittsburgh.

MOTORS—Savings on service costs of "Lo-Maintenance" squirrel cage induction motors highlight an

illustrated bulletin in color, No. 1195, published by Allis-Chalmers, Milwaukee. Action shots under adverse conditions show how these motors run for years without servicing. Cut-away and sectional photographs explain important design details. Included is a useful chart of applications of common types of squirrel cage motors.

BEARINGS—Complete details of various types of ball and roller bearings made by The Ball & Roller Bearing Co., Danbury, Conn., are given in an 80-page illustrated catalog, No. 15, just published. Useful information for the designer is also contained in tables in the back of the catalog covering allowable loads on steel balls and conversion tables. The book has long reference value.

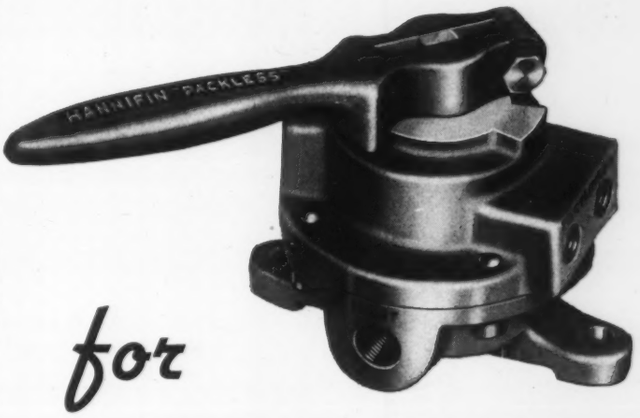
CONTROLS (ELECTRICAL)—The new D-51 full-voltage magnetic motor starter made by General Electric Co., Schenectady, N. Y., is described in an illustrated folder in color, GEA-2964, just issued. Numerous photographs explain all details of the switch. Points emphasized are small size, convenience of installation, ability to withstand hard use, and ease of mounting in machines.

CYLINDERS—Hanna Engineering Works, Chicago, has just issued catalog 228 containing complete specifications and details of cushioned and noncushioned air cylinders. Brief descriptions accompany the diagrams. Other Hanna products discussed in the latter part of the book include hoists, hydraulic cylinders and valves for mounting on the air cylinders. Photographs and drawings are plentiful.

PUMPS—Meehanite Metal Corp., Pittsburgh, has published a technical booklet showing how Meehanite can be used for pump castings when high operating efficiencies and longer wearing qualities are desired. General engineering specifications of the material aid in selection of the proper grade, and photographs, photomicrographs, and graphs add to the book's utility. Other information on Meehanite is included.

PUMPS—Rotary displacement pumps for handling fuel and crude oils, lubricating oils and hydraulic oil, are described in catalog L-31 issued by the De Laval Steam Turbine Co., Trenton, N. J. The book is copiously illustrated with both sectional and actual working pictures of the pumps, which have only three moving parts.

STEEL—The Steel Products Manual has been published by the American Iron and Steel institute, New York, giving definitions, classifications, and brief discussions of manufacturing processes for various types of rolled steel structural sections. Diagrams are helpful in illustrating points.



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Business and Sales Briefs

APPOINTMENT of C. F. Reeves as manager of the New York sales branch of the plastics division of Monsanto Chemical Co., St. Louis, has been announced. F. A. Abbiati has been appointed sales manager of sheet plastics. Promotion has been received by S. A. Bell from within the sales organization to assistant sales manager in charge of sheets, rods and tubes under Mr. Abbiati. Nitrocotton sales will be combined with sales on molding compounds with W. W. Powers in charge of nitrocellulose sales under George Gress, sales manager of molding compounds. All divisional sales executives are under John H. Clark, general manager of sales.

♦

According to a recent announcement by C. Donald Dallas, president of Revere Copper & Brass Inc., Louis J. Galbreath has been appointed technical advisor for the New York district sales division with headquarters at 75 East Forty-fifth street, New York.

♦

After twenty-seven years of active service, Harry J. Porter has resigned as vice president of Timken Roller Bearing Co., Canton, O. He is being retained in a consulting capacity.

♦

Dingle-Clark Co., contracting engineers, will represent John Waldron Corp., New Brunswick, N. J., in promoting sales of Waldron gear type flexible couplings, through its offices in Cleveland, Pittsburgh and Philadelphia.

♦

Opening of an office in Rockford, Ill., in charge of H. L. O'Donnell, has been announced by Allen-Bradley Co. Mr. O'Donnell was formerly in charge of the Chicago office.

♦

A new branch office and warehouse in Newark, N. J., has been established by Allis-Chalmers Mfg. Co., Milwaukee, to operate as a branch of the New York district office. The new branch will be under the management of C. A. Pihl.

♦

Ray B. Hoover, formerly vice president and general manager, has been elected president of Shafer Bearing Corp., Chicago.

♦

Fred E. Barth, of Graton & Knight Co., Worcester, Mass., has been appointed president of the American Belting association.

♦

Summerill Tubing Co., Bridgeport, Pa., has added Arthur J. Williamson to its technical staff as metallurgical

engineer in charge of research and development. During the last four years Mr. Williamson has been research metallurgist at John A. Roebling's Sons Co.

♦

Zenith Metal Products Co. Inc., has appointed Russell F. Mathews as representative of their plastics division in the western part of Ohio, and Michigan. His offices will be located at 7310 Woodward avenue, Detroit.

♦

Under license from Westinghouse Electric, the standard and special alloy nonferrous castings, known as Cupaloy, are available through the A. W. Cadman Mfg. Co., Pittsburgh. Cupaloy, having the thermal and electrical properties of copper, can be used for resistance welding electrodes, holder jaws and clamps, motor and generator parts, etc.

♦

Youngstown Sheet & Tube Co. has been licensed by Inland Steel to produce the lead-bearing steel, Ledloy.

♦

After 40 years of continuous service, Ira Gibben has retired from his position as assistant to the manager of the Pittsburgh district of American Steel & Wire Co.

♦

A new plant of United American Metals Corp., Brooklyn, N. Y., has been opened in San Francisco for the manufacture of the company's line of babbitt metals, solder and bushing bronze. The plant, located at 785 Bryant street, will serve the west coast territory.

♦

E. E. LeVan, formerly general sales manager, has been elected vice president of Haynes Stellite Co., a unit of Union Carbide & Carbon Corp.

♦

New York offices of J. H. Williams & Co., manufacturers of drop forgings, have been moved to 75 Spring street.

♦

Completion of a new brass and copper mill at Rome, N. Y., has been announced by Revere Copper & Brass Inc., New York. This modern plant will place the company in a better position to handle increased volume and at the same time give customers improved products.

♦

A molding powder division has been created by Celluloid Corp., New York, as a division of its sales department. William T. Cruse is director of sales of the new department.

♦

Appointment of Victor E. Williams as assistant general manager of sales of Monsanto Chemical Co., has recently been announced. Mr. Williams, formerly manager of New York sales for the company, will divide his time between New York City and St. Louis, headquarters of the organization. A. T. Loeffler, who has been assistant manager of the New York branch will succeed Mr. Williams as manager of New York sales.

♦

Previously sales manager, W. S. Edsall will replace George A. Burnham, recently resigned, as assistant manager of the electrical department in charge of

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• Farval today is delivering protection to more than a million points of lubrication—increasing the earning power of the production machines of principal industries.

The Farval Centralized System lubricates bearings correctly by delivering the lubricant, under high pressure, in exact, measured quantities, at proper intervals to every bearing —missing none.

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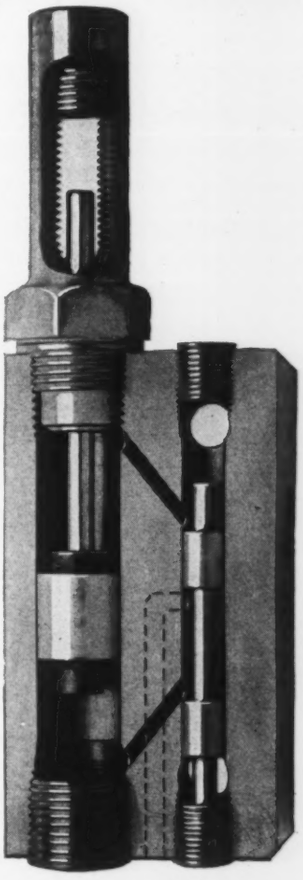

The positive piston-displacement Farval Valve, used to control the delivery of lubricant at each bearing, has but 2 moving parts and is extremely simple in operation.

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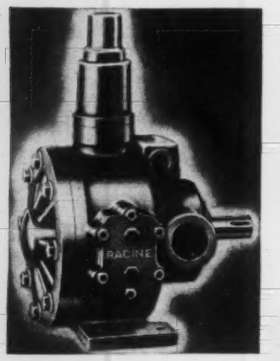
Variable Volume Hydraulic Pumps



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The Variable Volume feature saves horse-power. Delivers amount of oil actually required. Volume is controlled automatically or manually.

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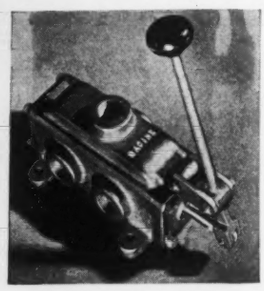

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switchgear sales and engineering division of Condit works of Allis Chalmers Mfg. Co., Boston. Mr. Burnham will be retained in a consulting capacity.

♦

Plans for an initial unit of a new plant near Sheffield, Ala., to produce ferroalloys, alloyed specialties, etc., have been announced by Electro Metallurgical Co., New York.

♦

W. R. Swoish has been appointed sales manager of Roller-Smith Co., 233 Broadway, New York. His headquarters will be at Bethlehem, Pa. Mr. Swoish previously was connected with Westinghouse Electric & Mfg. Co. as switchgear supervisor for the Northwestern district of the company.

♦

Election of G. Clifford Livezey, formerly of W. S. Hurst & Co., as president of Metals Coating Co. of America, Philadelphia, has recently been announced.

♦

Following appointments of new representatives have been announced by Foote Bros. Gear & Machine Corp.: A. C. Andrews, 1613 Bryan street, Dallas, Tex., as representative in northern half of Texas; W. M. Lee, 1409 California avenue, Houston, Tex., as representative covering Houston territory; and Industrial Engineering Co., Professional building, Charleston, W. Va., in charge of Southern part of West Virginia.

♦

Associated previously with Universal Plastics Inc., S. Leon Kaye has joined Consolidated Molded Products Corp., Scranton, Pa., as head of materials and research.

♦

A. H. Wheeler, who for ten years since graduating from Carnegie Tech has been representative of American Screw Co., Providence, has joined the sales organization of Lamson & Sessions Co., Cleveland.

♦

Aluminum & Magnesium Co. has been recently formed for the reclamation of aluminum and will be located at Sandusky, O. J. G. Frost is president of the new company; Edmund Christiansen, vice president; and Hugh M. Simpson, secretary and treasurer.

♦

Chicago Molded Products Corp., has moved its office to 1020 North Kolmar avenue, Chicago, the address of the new plant.

♦

Formerly vice president and general manager of Union Drawn Steel division of Republic Steel Corp., L. E. Creighton has been appointed manager of bar products, both hot and cold drawn, for Republic. Mr. Creighton in this newly-created post will establish his office at headquarters in Cleveland.

♦

Western Bearings Co. has appointed W. L. Sullivan as sales engineer in the Oklahoma and Texas oil field districts. Mr. Sullivan, who has been connected with the oil industry for several years, is well known throughout that territory.

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The Variable Speed Transmission
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Lengthens life of machines—Cuts operating costs. No expensive up-keep; uses standard V-Belts.

An infinite selection of speeds through a 5-to-1 range. Speed changed for different jobs, or different operations of same job.

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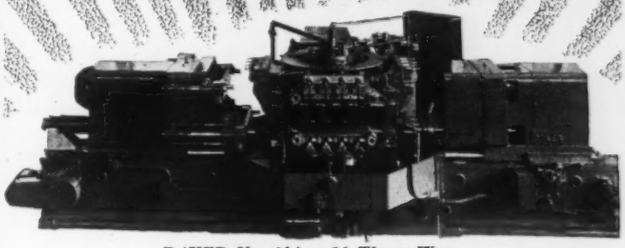

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This remarkable Baker machine takes care of four operations, accurately and at high speed—drilling, reaming, chamfering, and tapping—on steering handle support arms. Gear trains must be built to "take it" and that's why Baker chose Ampco Metal for vital gears.

The driving heads are equipped with Ampco Metal gears running with heat-treated, SAE 2340 steel gears. This combination successfully meets all demands for shock-proof, wear resistant, and silent operating qualities.

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"The Metal without an Equal"

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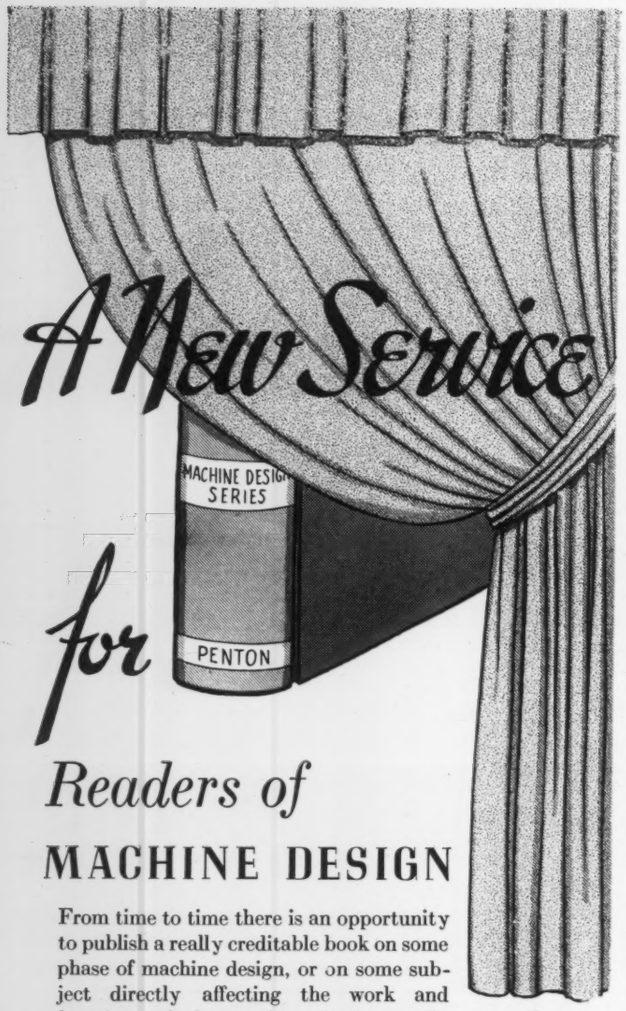

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Hay choppers, Dellinger Mfg. Co., Lancaster, Pa.
Combination hog and stock waterer, National Manufacturing & Stamping Co., Des Moines, Ia.

Air Conditioning

Oil burner, Burnham Boiler Corp., Irvington, N. Y.
Condensing unit, York Ice Machinery Corp., York, Pa.

Bakery

Heavy-duty dough mixer, Champion Machinery Co., Joliet, Ill.
Cross mixer, American Machine & Foundry Co., New York.
Dough molder, Thomson Machine Co., Belleville, N. J.
Dough rounder, Union Machinery Co., Joliet, Ill.
Dough divider, Read Machinery Co., York, Pa.

Domestic

Electric knife sharpener, Duwell Mfg. Co., Milwaukee.
Electric washer, Altorfer Bros., Peoria, Ill.
Electric range, Eureka Vacuum Cleaner Co., Detroit.
Automatic toaster, Utility Electric Co., St. Louis.
Folding iron, Chicago Electric Mfg. Co., Chicago.
Table washer, Voss Bros. Mfg. Co., Davenport, Ia.
Water heater, General Electric Appliance Co. Inc., Chicago.
Table range, Dominion Electric Mfg. Co., Mansfield, O.
Refrigerator, Gale Products, Galesburg, Ill.
Electric clock receiver, International Radio Corp., Ann Arbor, Mich.
Electric toothbrush, Simmons Mfg. Co., Chicago.
Disposal unit, General Electric Co., Nela Park, Cleveland.

Dry Cleaning

Dry cleaning machine, The Band Box Corp., St. Louis.
Pressing machine, Loyal Textile Machinery Corp., Brooklyn.
Electric steam iron, Steam-O-Matic Corp., New York.

Materials Handling

Lift truck with hydraulic table, Lyon Iron Works, Greene, N. Y.

Mining

Jaw crusher, Straub Mfg. Co., Oakland, Calif.

Printing

Curved plate casting box, Goss Printing Press Co., Chicago.
Paper cutter, Challenge Machinery Co., Grand Haven, Mich.
Two-color rotary press, Paper Converting Machine Co., Green Bay, Wis.
Photo-offset typewriter, Royal Typewriter Co., New York.

Refrigeration

Packaged commercial refrigeration, Westinghouse Electric & Mfg. Co., East Pittsburgh.

Restaurant

Slicing machine, U. S. Slicing Machine Co., LaPorte, Ind.
Fryer, Star Mfg. Co. Inc., St. Louis.
Automatic hamburger machine, Holly Molding Devices, Chicago.
Vending machine, Slector Products, St. Louis.
Electric can opening machine, Turner & Seymour Mfg. Co., Torrington, Conn.

Soap

Combination milling and plodding machine, Houchin Machinery Co., Hawthorne, N. J.

Shoe

Lasting machines, International Shoe Machine Corp., Cambridge, Mass.

Textile

Cloth tentering and carbonizing unit, Riggs & Lombard, Lowell, Mass.
Cloth conditioner, Jas. Hunter Machine Co., North Adams, Mass.
Dryer, Van Vlaanderen Machinery Co., Paterson, N. J.
Fur sewing machine, Singer Sewing Machine Co., New York.
High speed traverse plaiter, Birch Bros. Inc., Somerville, Mass.
Unirail twister, Atwood Machine Co., Stomington, Conn.
Yarn conditioner, Industrial Dryer Corp., Stamford, Conn.
Drying machine, Philadelphia Drying Machinery Co., Philadelphia.
Welt machine, Wildman Mfg. Co., Norristown, Pa.

Welding

Bandsaw welder, William Laidlaw Inc., Belmont, N. Y.
Spot welder, Thomson-Gibb Electric Welding Co., Lynn, Mass.
Arc welder, Lincoln Electric Co., Cleveland.

Woodworking

Single spindle shaper, Hutchinson Mfg. Co., Norristown, Pa.
Portable saw mill, Hart Bros. Machine Co., Clarksburg, W. Va.

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●

Machines have become so interwoven with our economic and social pattern that their identity as machines often is lost. When the word "machine" is mentioned some individuals form a mental picture of a machine tool or other large unit. This impression is entirely too limited in scope, the field of machines ranging from the tiniest wrist watch to the largest locomotive. MACHINE DESIGN likewise is all-inclusive, covering every size and type of machine produced.

Mechanical design knows no boundaries. Whether the unit is large or small, the same procedure must be carried out in the evolution of an idea. For that reason the designer of one type of machine often can find a solution to his particular problems in the accomplishments of design engineers in other fields.

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In plastic molding, it's in the making of the mold that superior craftsmanship and experience prove their value. Here the accuracy and precision which govern the quality of your job reflect the skill of our craftsmen.
At Auburn, precise accuracy starts with the die-making and continues clear through to the series of exacting inspections which have such an important bearing on your satisfaction with the finished job. Let an Auburn Engineer tell you the whole story.

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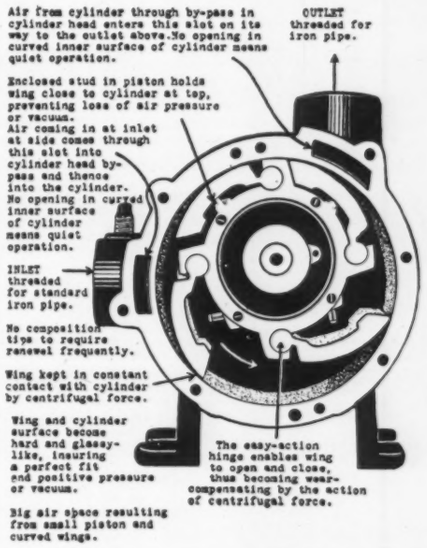
Air from cylinder through by-pass in cylinder head enters this slot on its way to the outlet above. No opening in curved inner surface of cylinder means quiet operation.
OUTLET threaded for iron pipe.
Enclosed stud in piston holds wing close to cylinder at top, preventing loss of air pressure or vacuum.
Air coming in at inlet at side comes through this slot into cylinder head by-pass and thence into the cylinder. No opening in curved inner surface of cylinder means quiet operation.
INLET threaded for standard iron pipe.
No composition tips to require renewal frequently.
Wing kept in constant contact with cylinder by centrifugal force.
Wing and cylinder surface become hard and glassy-like, insuring a perfect fit and positive pressure or vacuum.
Big air space resulting from small piston and curved wings.
The easy-action hinge enables wing to open and close, thus becoming wear-compensating by the action of centrifugal force.

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PATENTED ROTARY AIR PUMPS
PRESSURE
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A Machine That Takes Up Its Own Wear Automatically

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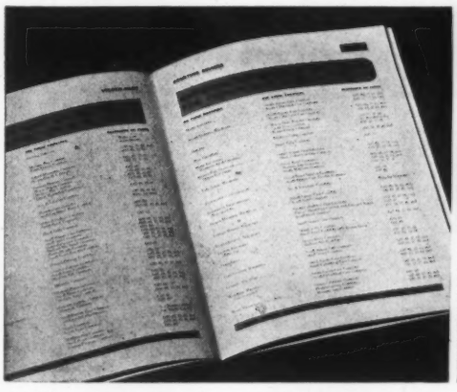
Inside information

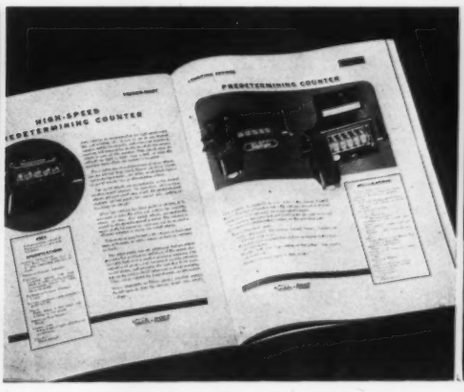
ON WHAT YOUR MACHINES CAN DO

Men responsible for the choosing—*and the buying*—of machines want the straight, inside information on what these machines are doing once they get on the job. And these men want *facts*—accurate, dependable records of the number of pieces turned out or volumes or lengths as well as starts, stops, and other operations . . . because this information forms the foundation for production and cost-control; for greater economy—as well as a guide for the purchase of additional machines. And the best, most economical way to give these men this necessary information is to build a Veeder-Root Counting Device into the machines you make.

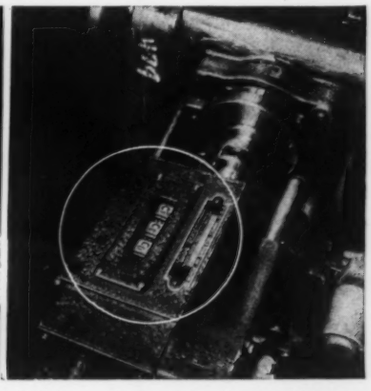
Simple as **A B C** *when you use this helpful catalog*



A. The quick-finding index in the Veeder-Root catalog lists, alphabetically, hundreds of machines and the types of counters that have been profitably installed on them.



B. You get complete information on the counters you want to use—what they will do for you, their dimensions, speeds, counting capacity, whether reset or non-reset, finish and operating instructions.



C. Many photographs in the Veeder-Root catalog show actual installations of counting devices. You see how easy and economical they are to install . . . How practical and visible they are to use.

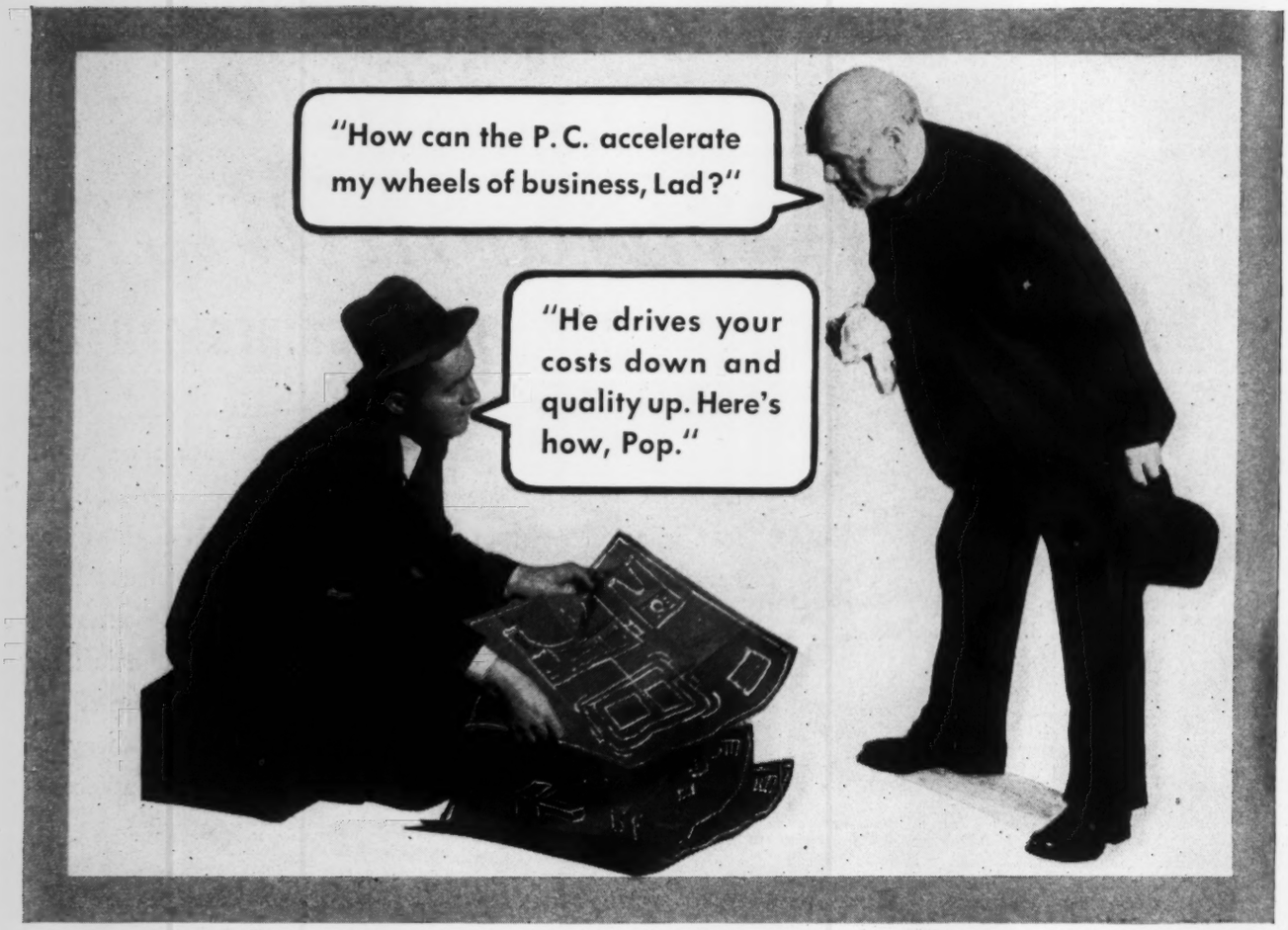
Hundreds of machines can profit by built-in Veeder-Root Counting Devices

Standard Veeder-Root Devices that count, measure or record have been profitably installed in punch presses, printing presses, vending machines, typewriters, cutters, winders, twisters, addressing machines and many others. Moreover, specially designed Veeder-Root Devices have added salability and utility to gasoline pumps, voting machines, electric and water meters, fuel oil meters. Veeder-Root engineers are constantly working with manufacturers on new applications. *Find out more about these counting devices. Send for complete catalog now.*

VEEDER-ROOT incorporated

Hartford, Connecticut, U.S.A.

Offices in Boston, Chicago, Cincinnati, Cleveland, Detroit, Greenville, S. C., Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Montreal, Canada, Buenos Aires, Mexico City, London, Paris, Tokio, Shanghai, Melbourne



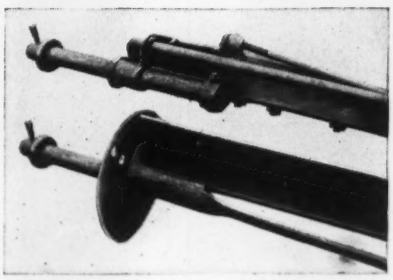
HOW YOU CAN PROFIT MOST WITH WELDING

● "Let's look at the records, Pop. Here's one company whose business grew from $200,000 to $5,600,000 in 6 years—largely through the drive of their P. C. (story on request). I could cite hundreds of cases of companies that have followed the plan I'm going to tell you about and who are today getting more r. p. m. and fewer

squeaks from their wheels of business.

"The plan is simply this: Call to arms a crusading executive with a yen for welding and give him the authority to 'go to town.' Since the results of his efforts are increased profits, we call him the Profit Crusader, or P. C.

"Here is an example of the work of the Profit Crusader in one plant. The part is an axle of a hay rake, formerly consisting of an assembly of castings and truss rod which frequently became loose in service, requiring repair. The Profit Crusader took an angle iron, flat bar and plate and welded them into a permanently rigid unit. The farmer got a shimmy-proof hay rake and the manufacturer saved 30% on the part.



"There's an attractive booklet available for the asking which gives some valuable suggestions for the Profit Crusader. Write for a free copy. And by all means, get in touch with the nearest Lincoln office. These people will do you and your wheels of business many a good turn."

Largest Manufacturers of Arc Welding Equipment in the World

THE LINCOLN ELECTRIC COMPANY

DEPT. C-566 **CLEVELAND, OHIO**

NEW POSSIBILITIES!

IN THE *Graham* VARIABLE SPEED TRANSMISSION

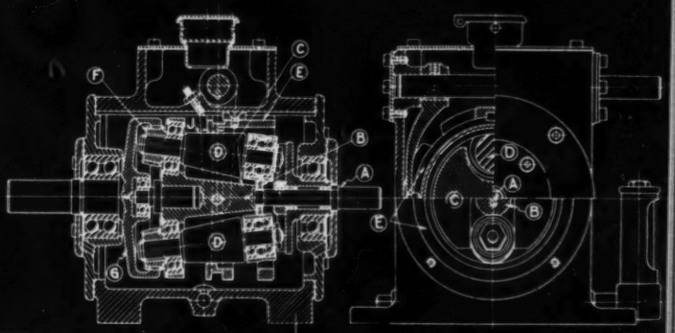
New in *COMPACTNESS*—no bigger in diameter than the motor and requires no added fastenings. New in *RANGE*—any speeds whatever, in infinite steps, from any desired maximum down to zero and reverse. New in *POWER*—develops full motor power (constant power) over 4:1 range and full torque over the *entire* range to zero. New in *ECONOMY*—does more than previous transmissions but costs no more. Write for Bulletin No. 323, giving prices, dimensions and ratings of units from 1/8 HP to 10 HP.

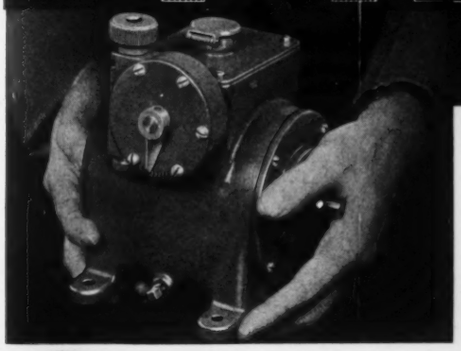
GRAHAM TRANSMISSIONS INC.

2711 North 13th Street • Milwaukee, Wis.

MANUFACTURED BY BRIGGS & STRATTON MILWAUKEE, WIS.

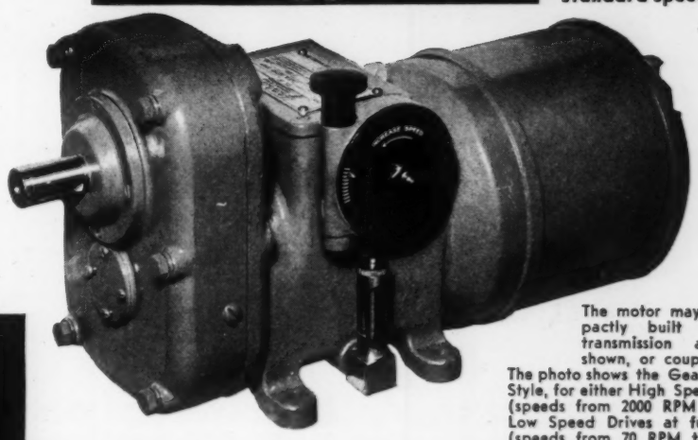
FOR THE MACHINE DESIGNER





SMALLEST, MOST COMPACT

The blueprint above and phantom views below show the extreme simplicity of this all-metal, splash lubricated drive, which incorporates reduction and range in a single unit built like a standard speed reducer.

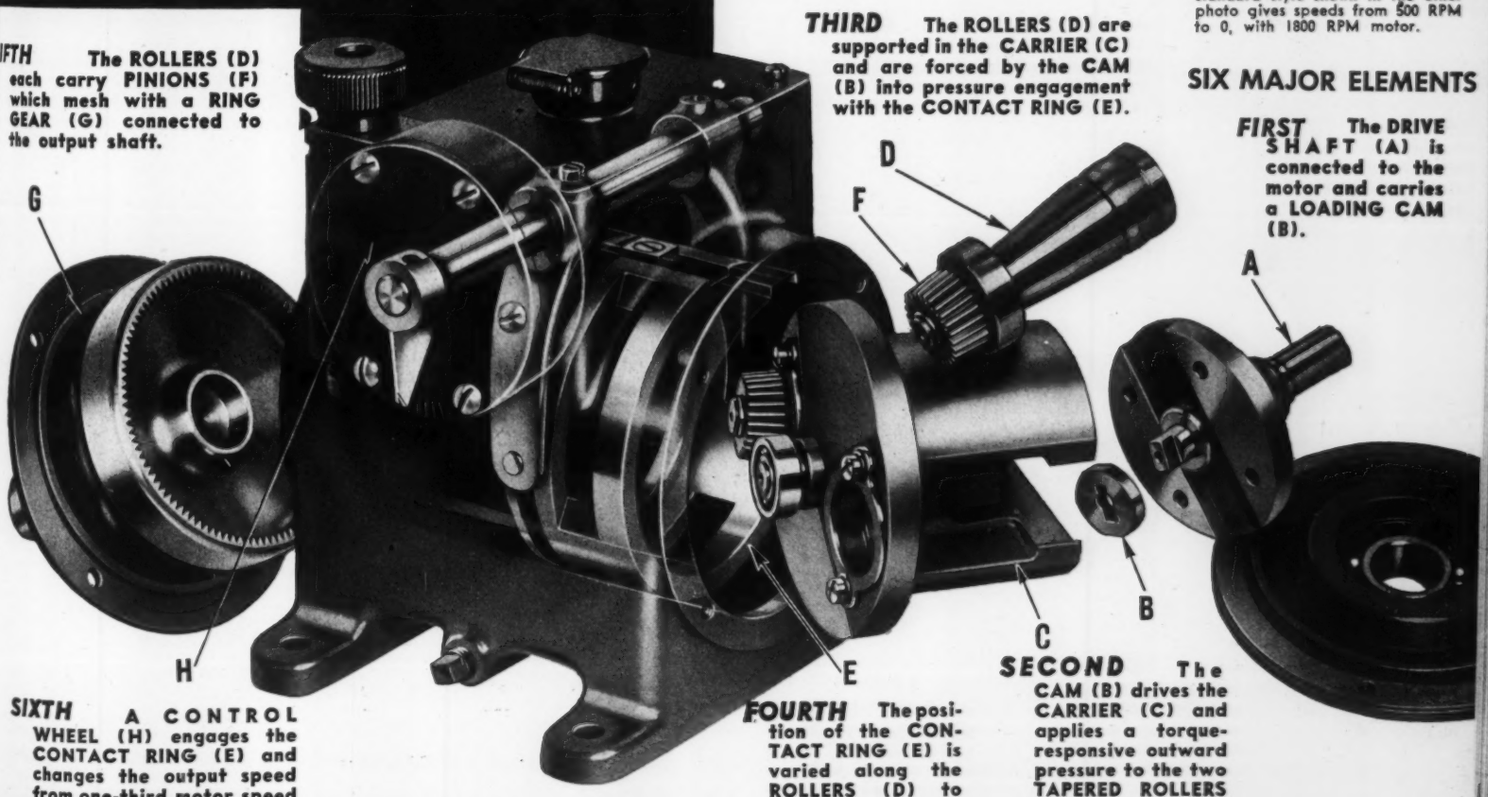


The motor may be compactly built into the transmission as here shown, or coupled to it. The photo shows the Geared Head Style, for either High Speed Drives (speeds from 2000 RPM to 0) or Low Speed Drives at full torque (speeds from 70 RPM to 0). The standard style shown in the other photo gives speeds from 500 RPM to 0, with 1800 RPM motor.

EXTREME *Simplicity* . . . 6 MAJOR ELEMENTS

FIFTH **The ROLLERS (D) each carry PINIONS (F) which mesh with a RING GEAR (G) connected to the output shaft.**

THIRD **The ROLLERS (D) are supported in the CARRIER (C) and are forced by the CAM (B) into pressure engagement with the CONTACT RING (E).**



SIX MAJOR ELEMENTS

FIRST **The DRIVE SHAFT (A) is connected to the motor and carries a LOADING CAM (B).**

SECOND **The CAM (B) drives the CARRIER (C) and applies a torque-responsive outward pressure to the two TAPERED ROLLERS (D).**

FOURTH **The position of the CONTACT RING (E) is varied along the ROLLERS (D) to change the speed.**

SIXTH **A CONTROL WHEEL (H) engages the CONTACT RING (E) and changes the output speed from one-third motor speed through zero to reverse.**